

Dear Colleague:

LIVING COLLECTIONS  
Summer, 2004

Enclosed please find sample narratives, schedules of completion, and summary budgets from three successful applications from the 2004 IMLS Conservation Project Support (CPS) grant competition.



INSTITUTE  
of MUSEUM  
and LIBRARY  
SERVICES

The attached samples were selected because they demonstrate how individual institutions with different conservation needs successfully developed projects that address those needs. We feel these narratives are logically and clearly presented, and give sufficient information to support the request.

This packet contains three samples that represent different types of conservation projects. They emphasize the overall institutional conservation perspective, the involvement of conservation professionals in all phases of the project, and the importance of the project as the highest institutional priority for collections care.

In addition, there are three samples of funded education components. We hope that these samples give you the impetus to partner with your staff educators to develop your own creative way to educate the general public about your conservation project.

The samples included in this packet are listed on the back of this letter. No endorsement by IMLS of any personnel, conservation facilities, private firms, or conservation procedures and methods identified in the narratives should be assumed.

I hope that these sample narratives will be useful to you as models for structuring a proposal for your conservation needs. IMLS program staff is available at (202) 606-8539 or [imlsinfo@imls.gov](mailto:imlsinfo@imls.gov), and will be happy to discuss any questions you have as you develop your proposal.

The application deadline for the 2005 Conservation Project Support grant program is:

**October 1, 2004**

Applications for CPS are available from the IMLS Web site (<http://www.imls.gov>), or by calling IMLS at 202-606-8539. We look forward to receiving your application.

Sincerely,

Mary Estelle Kennelly  
Associate Deputy Director for Museum Services  
IMLS

**Sample Conservation Projects: Living Collections**

<u>Project Type</u>	<u>Museum</u>	<u>State</u>	<u>Award</u>	<u>Match</u>	<u>Project</u>	<u>Budget</u>	<u>Discipline</u>
Environmental	University of CA, Davis Arboretum	CA	\$49,829	\$95,410	\$145,239	\$876,672	Arboretum
Research	Cincinnati Zoo & Botanical Garden	OH	\$75,000	\$173,904	\$248,904	\$19,246,632	Zoo & Garden
*Research	Toledo Zoo	OH	\$55,759	\$98,754	\$154,513	\$22,383,141	Zoo

\*also has sample education component

**Sample Education Components:**

<u>Museum</u>	<u>State</u>	<u>Education Award</u>	<u>Total Grant Award</u>
Historic St. Mary’s City	MD	\$9,924	\$59,904
Toledo Zoo	OH	\$9,607	\$55,759
Arizona State University Art Museum	AZ	\$8,236	\$22,423

## **Davis Arboretum**

Davis, California

Project Type: Environmental Improvements

IMLS Award: \$59,829

Match: \$95,410

Total Project: \$145,239

Museum Budget: \$876,672

## NARRATIVE QUESTIONS-CONSERVATION PROJECT

### 1. WHAT IS THE DESIGN OF THE PROJECT?

We propose to improve environmental conditions and treat individual specimens in the oak collection of the University of California Davis Arboretum. Additionally, we will train Arboretum staff and campus Grounds staff in conservation practices necessary to safeguard the health of the collection. Specifically, we propose to implement the recommendations in a recently-completed detailed survey of the condition of the collection, which was supported by a previous Conservation Project Support grant from IMLS (see attached report). The goals of the conservation project are to bring environmental conditions in the oak grove up to professional standards, to provide corrective treatment for trees at risk of structural failure or showing symptoms of disease, to institute new systems and standards to safeguard the health of the collection, and, through staff training, to increase our capacity to conserve our collections in the future. Components of the conservation project will include:

- **Renovation and extension of the irrigation system in the oak grove.** A recent water audit determined that irrigation in the grove is uneven, resulting in inadequate water in some areas, which produces drought stress, and soil over saturation in other areas, which limits root growth and contributes to fungal disease. Only part of the grove has an automatic irrigation system; the rest must be irrigated manually, which is very labor-intensive. Damaged or improperly installed lines and heads compound the problem. We plan to bring the existing irrigation system up to professional standards, following the recommendations in the attached water audit.
- **Improvement of the surface of the grove** with the addition of a six-inch layer of organic mulch. This will reduce soil compaction, which limits root growth, and minimize dust, which encourages spider mite infestations. Mulching will also improve visitor access to the collection.
- **Soil aeration to reduce compaction and improve infiltration rates.** Compacted soil limits root growth and reduces the rate at which irrigation water can penetrate the soil, leading to runoff and drought stress. We will aerate the soil using a deep penetrating core aerator.
- **Treatment of specimens infected with pests or pathogens.** The recent condition survey identified a number of trees with symptoms of Phytophthora root or crown rot and/or iron chlorosis (28 trees), twig or branch dieback due to infection with fungi or bacteria (22), or infestation with carpenterworm (3). Treatment will include pruning to remove diseased wood, modifications to maintenance practices, addition of iron chelate or sulfur to the soil, and application of systemic fungicides if necessary.
- **Investigation of methods of reducing nesting bird colonies.** During the past several years, large colonies of black-crowned night herons (*Nycticorax nycticorax*) have begun nesting in the oak grove. According to the recent condition survey, their feces are coating the leaves of the affected trees, causing leaf drop, and changing the chemical composition of the soil around the trees. They are certainly an inconvenience and possibly a health hazard for visitors. We are currently in the process of preparing a Wildlife Management Plan in consultation with UC Davis researchers, and will investigate options for discouraging nesting.
- **Corrective pruning on structurally unsound trees.** A recent risk assessment rated individual trees in the grove for risk of tree failure on a scale of 4 to 16 based on the rating system in Metheny and Clark, *Evaluation of Hazardous Trees in Urban Areas*, 1994. Sixty-two trees (19%) had a rating of 8 or higher, indicating moderate to severe risk. We plan to contract with John Lichter, MS, consulting arborist, to do corrective pruning on these trees and train staff in advanced pruning techniques.
- **Training for Arboretum and campus staff** in monitoring and corrective treatment of mature specimen trees. We will train staff to monitor the collection for evidence of disease and pest problems, including Sudden Oak Death (SOD), a disease caused by the pathogen *Phytophthora ramorum*, which has reached epidemic proportions in the coastal areas of California. Our recent condition survey did not detect the presence of SOD in the collection; vigilant monitoring will be necessary as long as the disease continues to spread. Additionally, we will train staff in hazard evaluation and corrective pruning techniques for use with mature trees.

- Modifications to current maintenance practices. We will develop and implement a new irrigation regime, pruning schedule, and standards and schedules for monitoring, diagnosing, and treating pests or pathogens in specimens in the collection.

The proposed project will be carried out over a 24-month period, from May 2004 through April 2006. This time line allows for the need to schedule according to weather, tree dormancy, and use constraints, and allows adequate leeway for aligning the project schedule with ongoing demands on Arboretum and campus staff. We anticipate that Arboretum professional staff will spend 776 hours and a student assistant will spend 500 hours on this project.

## **2a. WHAT ARE THE PROPOSED CONSERVATION METHODS AND WHY ARE THEY CONSERVATIONALLY SOUND?**

The University of California, Davis is one of the most prominent plant science research and teaching institutions in the world. The Arboretum strives in all its operations to reflect the excellence of the University, and to make use of the most current research and thinking in the field. John Lichter, our conservation consultant, teaches in the Department of Environmental Horticulture and Urban Forestry at UC Davis, serves on the board of the American Society of Consulting Arborists, and chairs the Research Committee of the International Society of Arboriculture Western Chapter; his work keeps him abreast of the latest findings.

The conservation practices that will be used to improve environmental conditions, correct structural weaknesses, and treat pests and disease in the Arboretum's oak collection are established practices in the fields of arboriculture, horticulture, and environmental management. We have used these techniques on a smaller scale in other areas of the Arboretum, and have determined that the procedures proposed here are the most efficient and effective at safeguarding the health of the living collections.

To improve environmental conditions we will upgrade the irrigation system, implementing the recommendations of a detailed water audit and soil moisture measurements taken at several depths and multiple locations throughout the grove (see attached report). We will resurface access roads and paths with a six-inch layer of mulch to control dust and reduce spidermite populations that thrive in dusty conditions. We will aerate compacted soil using a deep penetrating core aerator. We will investigate our options for reducing nesting bird colonies.

Conservation pruning for mature trees has the goal of restoring a reasonable branch scaffold, renewing the crown, and correcting structural defects. Methods include crown cleaning, crown thinning, crown raising, crown reduction, and pruning to remove dead and diseased wood.

The policy of the Arboretum is to control pests and disease using the least toxic methods that will give effective results; we use cultural, physical, and biological controls wherever possible and resort to chemical controls only when an infestation cannot be controlled otherwise. For this project we anticipate pruning out diseased wood to control fungal, viral, or bacterial pathogens, treating chlorosis (a chemical imbalance) by applying iron chelate and/or sulfur to the soil, and reducing dust to control spidermites.

All work done at the University of California is subject to stringent safety requirements. All Arboretum staff, students and volunteers are safety-trained and must be tested and cleared before handling power tools, vehicles, or heavy equipment. Precautions to ensure the safety of the collection are addressed elsewhere in this document.

## **2b. DESCRIBE YOUR RATIONALE FOR THE PROPOSED TRAINING CURRICULUM**

We propose to train Arboretum staff and campus grounds supervisors in conservation practices for mature specimen trees. The training will be conducted by our consulting arborist, John Lichter, MS, in a workshop format, both in the classroom and in the field, which draws on and extends training courses Mr. Lichter has taught for the International Society of Arboriculture and the Department of Environmental Horticulture at UC Davis (see draft curriculum, attached). The 24 hours of training will include lectures, demonstrations and hands-on, supervised work on the trees in the collection.

This training will benefit the participants by upgrading their skills and knowledge in their field of work and preparing them to assume more responsibility on the job. It will benefit the Arboretum by increasing our

capacity to manage the conservation of our collections in a more proactive and sustainable fashion, using in-house expertise on an ongoing basis and reducing our reliance on consultants and contractors.

### **3. WHAT ARE THE SPECIMENS THAT ARE THE FOCUS OF THIS PROJECT?**

The oak collection of the UC Davis Arboretum includes 398 specimens representing 131 taxa (species, subspecies, and hybrids). Of these, 320 trees are located in the Shields Oak Grove, which is the focus of this project. These include species from a wide geographic range, with an emphasis on arid-climate oaks from California, the western U.S., Mexico, and the Mediterranean basin. Most of these trees were grown from acorns collected in the wild, and the Arboretum curatorial records include information on where, when, and by whom they were collected and a detailed description of the site, conditions, and associated species of their native habitat. The collection also includes 30 artificial hybrids developed by Dr. Walter P. Cottam of the University of Utah.

The oak collection is the most prominent taxonomic collection at the UC Davis Arboretum in terms of number of specimens and size (acreage) of display, and is probably the most scientifically significant collection. The oak collection supports all of the seven stated goals of the Arboretum (see page 7.12); it is used extensively as a resource for the teaching and research activities of the University, for public education and outreach, as a demonstration of regionally-appropriate horticulture, and for recreation.

The oak collection and other taxonomic collections at the UC Davis Arboretum were formed to support the teaching and research functions of the University, and remain an important resource for researchers and educators. Due to the difficulty of obtaining living research materials from a broad sample of geographically distant plants within a taxonomic group, complex genetic, biochemical and ecological studies are often conducted on very limited research samples. The Arboretum's collection of slowly-maturing but long-lived oak species and the extensive documentation maintained on individual specimens are thus invaluable to scientists.

Recently, the oak collection has played a role in the fight against the devastating epidemic of the Sudden Oak Death pathogen now affecting wild oaks in California. Dr. David Rizzo, identifier of the pathogen and a member of the California Oak Mortality Task Force, the statewide scientific effort to develop methods of control, has conducted research on specimens in the Arboretum collection.

Sizeable collections of mature oaks are uncommon in botanic gardens due to space restrictions, the difficulty of propagating oaks vegetatively, their propensity for hybridizing, perishable seeds, and the fact that they may take decades to reach reproductive maturity. The nation's most prominent collections of oaks are at arboreta of the east coast and the Pacific northwest. Many of the oaks of the arid southwest and subtropical Central America are not tolerant of moisture or cold-hardy enough to grow in these climates. The UC Davis Arboretum is the only institution in the southwestern United States with a large collection of mature oaks, and the collection is particularly strong in species from arid climates.

The oak collection provides information on the ability of various species to thrive in the Mediterranean-type climate of California's Central Valley. The collection is a resource for introducing oaks of extraordinary horticultural merit into cultivation.

The Arboretum oak collection includes specimens of several taxa identified as rare or of concern. Documenting propagation methods for these plants, displaying them to educate the public about their status, and encouraging their use in cultivation are all part of our efforts to ensure their continued survival.

Some specimens in the oak collection are also historically significant. Several massive valley oak trees, now accessioned as part of the Arboretum collection, served as boundary markers for the Laguna de Santos Calle Mexican land grant and appear on the earliest maps of this area.

The training component of the project will benefit the entire plant collection of the Arboretum, which includes approximately 21,500 specimens of more than 4,000 taxa of plants adapted to the heat and drought of a Mediterranean-type climate. Major collections in addition to the oaks include California native plants, plants from other Mediterranean-climate regions (South Africa, Chile, and Australia, as well as the Mediterranean basin), conifers, acacias, and plants of the American deserts. We plan to include the campus landscape supervisors in the training, so this component will also benefit the entire UC Davis campus, part of which has been developed as a teaching landscape for classes in environmental horticulture, plant biology, landscape architecture, and other disciplines.

#### **4. HOW DOES THE PROJECT RELATE TO YOUR MUSEUM'S ONGOING CONSERVATION ACTIVITIES?**

Responsibility for the routine maintenance of the UC Davis Arboretum collection is held by the Arboretum Superintendent and the Director of Horticulture. Garden inspections, attended by the superintendent, horticultural curator, and groundskeepers are made on a regular basis and generally cover a single arboretum collection or garden. A detailed list of tasks to be completed is drawn up to serve as a record of the inspection, a work list for the garden groundskeeper, and later as a checklist for completed work. This simple but effective management tool allows senior staff to evaluate the condition of the specimens over a period of time and advise on horticultural procedures to properly maintain them.

Strict departmental and campus regulations control pesticide and chemical use in the Arboretum. Our Integrated Pest Management (IPM) program helps conserve important plants within the collection without adversely affecting research underway in the Arboretum.

The collection inventory is a relational database linked to a set of electronic maps. Computers are backed up on a daily basis; backup sets are rotated to ensure that data accidentally destroyed can be recovered. Copies of plant records in both printed and electronic form are maintained off-site to reduce the risk of destruction by fire or other causes.

Periodically, as funding allows, we conduct detailed horticultural and curatorial evaluations of the collections. In 1988, a general survey of the conservation needs of the California native plant collection was completed. This survey, funded in part by the IMLS, allowed us to establish a prioritized Long Range Conservation Plan for the California native plants included within our collection. During the following three years, with this long-range plan in hand, we successfully completed over \$100,000 worth of conservation activities with most activities funded by matching grants from other organizations. In 1992, with additional funding from IMLS, we developed a Conservation Monitoring System for our California Native Plant Collection, in which the data previously gathered in the conservation survey on the conservation needs of individual specimens is linked to the computerized maps and data base. All plants requiring a particular conservation treatment can be highlighted on a map and seen at a glance. The value of this system for routine garden inventorying, cataloging, and records maintenance is profound.

In 1999, we participated in assessments under both the MAP and CAP programs. The CAP assessment, conducted by Linda McMahan, Director of the Berry Botanic Garden, addressed critical strategic needs of the institution with an analysis of general museum systems, and highlighted the importance of increasing horticultural staff and planning for collection development (see Executive Summary, attached). The MAP assessment was conducted by Nancy Morin, Director of the Arboretum at Flagstaff and former Executive Director of the American Association of Botanical Gardens and Arboreta. She concluded that "[t]he collections represent priceless local, regional, national and international resources. They are a community investment, and support must be given for their long-term curation."

Also in 1999, we completed a detailed curatorial analysis of our oak collection and compiled records on the value and significance of the collection, the history of collection development, an inventory of the collection, maintenance, interpretation, and funding status. We then prepared detailed recommendations for additions to and conservation of the collection (see Final Recommendations, attached).

In 2003, funding from an IMLS Conservation Project Support grant allowed us to undertake an in-depth assessment of environmental conditions and the condition of individual specimens in the oak grove (see report, attached). The project included detailed documentation of current maintenance and conservation practices, such as irrigation, pruning and pest control schedules; examination of each individual tree to identify visible signs of stress, pest damage, or pathogens and to document the need for corrective pruning or other structural treatment; excavation of soil sampling pits to allow staff to examine root density and distribution and collect data on soil texture, color, composition and density; laboratory analysis of soil chemistry; a water audit to evaluate the current irrigation system; and data analysis correlating environmental conditions with the health of individual trees. Our consulting arborist developed recommendations to help us modify our cultural practices, institute the best possible irrigation regime, prioritize major pruning work, and make decisions about how to treat diseased trees or whether any trees should be removed. The proposed conservation project will be an implementation of those recommendations.

We have identified the oak collection as the most in need of conservation for three major reasons. First, the Arboretum has been invited to apply for inclusion of the oak collection in the North American Plant Collections Consortium. According to our MAP assessment, "The Davis Arboretum Oak Collection almost certainly would be accepted into the NAPCC. This would bring broader use and greater recognition to the collection and to the Arboretum." Participation in NAPCC requires a significant commitment on the part of the institution, including "developing, documenting, verifying, maintaining, sharing, propagating, and disseminating the plant collection." Completing the proposed conservation activities would provide the basis for adding the oak collection to the Consortium. Secondly, the devastating spread of the Sudden Oak Death (SOD) pathogen in wild oaks in California makes clear the need for diligent monitoring and protection of important oak specimens in botanical garden collections (see USDA Pest Alert, attached). Finally, we have received a generous endowment to support the conservation and development of the oak collection from Dr. John Tucker, Professor Emeritus of Botany at UC Davis, who led the development of the collection in the 1960s. The endowment is an indication of the value of the collection for research and teaching. The proposed conservation project will lay the groundwork for further development and continued care of the collection.

The Arboretum has made a significant institutional commitment to the conservation of the collections. Our 1998 Strategic Plan identified increasing the size of the horticultural and curatorial staff as a critical need. Since then we have successfully advocated for full-time, permanent funding for the Curator and Director of Horticulture positions, and have added two full-time positions, Horticultural Curator and Nursery Manager, as well as a part-time Assistant Curator and additional student gardeners. We have also improved our coordination with the campus Grounds Division and advocated for significant increases in in-kind donations of labor, equipment, and special services from the Grounds staff.

Our Curator, Horticultural Curator, and Director of Horticulture are in the process of documenting and standardizing horticultural maintenance schedules and practices for the entire collection. This is part of the process of transition as we prepare for the retirement of the Arboretum Superintendent after more than 30 years on the job. We are attempting to "download" the tremendous amount of information he carries in his prodigious memory.

We have a special commitment to conserving the oak collection because of its value to researchers. Our Horticultural Curator conducted the curatorial analysis of the oak collection mentioned above to prepare us for an extended conservation effort. We have received two grants from the Elvenia Slosson Fund for research on vegetative propagation of oaks. Our Nursery Manager is working with prominent oak experts to investigate propagation methods such as tip cuttings, stump sprout cuttings, hedging (severe pruning to encourage sprouting), etiolation (excluding light to promote tender growth), and grafting. This work is designed to identify methods of cloning individual oaks that demonstrate desirable characteristics such as disease resistance or unusual form (see preliminary report, attached).

## **5. WHAT ARE THE ANTICIPATED BENEFITS OF THE PROJECT?**

The long-term benefits of the proposed project will be improved health and longevity of the Arboretum's oak collection, which will benefit researchers, educators, students, and visitors who use the collection for study, recreation, or pleasure. The collection has particular value for teaching and research by UC Davis faculty and students in Plant Biology, Environmental Horticulture, Ecology, Wildlife and Conservation Biology, and related disciplines. The project has the potential to contribute to the preservation of oak biodiversity in the wild, since the collection represents a repository of documented genetic material that can be used for research, teaching, or ecological restoration.

This project will strengthen the Arboretum's application for inclusion of the oak collection in the North American Plant Collections Consortium. Admission to the Consortium is selective and participants must meet strict standards for collections management. Inclusion of the oak collection in NAPCC will benefit researchers worldwide.

Additional benefit to Arboretum visitors will accrue from improved safety, as structurally unsound trees are pruned, braced, cabled, or removed, and improved access on mulched roads and paths.

## **6. HOW WILL THE APPLICANT ENSURE THAT ONGOING MUSEUM FUNCTIONS ARE NOT INHIBITED BY THESE PROJECT ACTIVITIES?**

Although the proposed project activities are large in scale, the small project staff will be relatively unobtrusive at work. Shields Oak Grove can be reached via a main path and from a lawn area. At any given time, either the lawn areas or the main path through the grove will remain accessible. Access for researchers will not be limited, except as small groups of trees are fenced off for pruning or treatment. Educational signage will interpret project activities and explain the necessity of keeping treatment areas off limits to visitors. Much of the work of the project will be done by consultants or by the campus Grounds Division, which will allow Arboretum staff to manage normal curatorial and horticultural activities during the project period.

## **7. HOW DOES THE PROJECT BUDGET SUPPORT THE PROJECT GOALS AND OBJECTIVES?**

The project budget was developed by determining the activities necessary to carry out the recommendations in the recent condition survey of the oak collection, and identifying the labor, supplies, equipment, and services necessary to carry out each activity. Labor costs were determined by estimating the amount of time needed for each activity, assigning specific staff, consultant, or volunteers to each task, and applying the hourly rates of the person(s) assigned. Similar activities have been carried out on a smaller scale in other areas of the Arboretum, so we were able to extrapolate time and costs for this much larger project. Material and equipment costs were determined by actual quotes from suppliers or records of recent purchases.

We believe that the estimated project costs are reasonable and appropriate to the scope of the project. The oak collection includes a large number of specimens, and most of them are mature trees of large size. The oak grove where the project will be conducted covers 7.5 acres.

We have used groundskeepers and entry-level professional staff whenever possible to keep costs down. The campus Grounds Division has generously agreed to provide irrigation construction and mulching, which allows us to use grant funds for to hire a highly skilled and respected consulting arborist for the actual treatment of the specimens in the collection. Because the consulting firm is located in our area, there are no travel or subsistence costs.

## **8. WHAT ARE THE QUALIFICATIONS AND RESPONSIBILITIES OF THE PROJECT PERSONNEL?**

Ellen Zagory, Director of Horticulture, will have overall responsibility for the project. She will meet regularly with project staff to plan and monitor project activities, oversee expenditures, and manage workflow. Ellen has been with the Arboretum since 1987 and holds a Master of Science degree in Environmental Horticulture from UC Davis, one of the top plant science schools in the world. Her horticultural expertise, her familiarity with the collection, her experience with similar collection evaluation projects elsewhere in the Arboretum, and her role as supervisor of horticultural staff make her participation essential to this project.

Emily Griswold, Horticultural Curator, will be responsible for the day-to-day work of the project. She will work with the consultant and serve as liaison to the campus Grounds Division and Facilities Services. Emily holds a Master of Science in Urban Horticulture from the University of Washington, Seattle. She prepared the original curatorial assessment of the oak grove on which this project is based, working closely with Dr. John Tucker, professor emeritus of Botany, former director of the Arboretum, and a world-renowned expert on oak taxonomy. Her familiarity with the collection, with the Arboretum's plant records system, and with curatorial standards and practices make her participation essential to this project.

John M. Lichter of Tree Associates will be the consulting arborist for the project. He will conduct in the training element of the project and carry out much of the corrective pruning. Mr. Lichter holds a Master of Science degree in Environmental Horticulture from UC Davis, and is well respected in his field as an expert on tree health, safety, and conservation through corrective treatment. Mr. Lichter is an active member of the American Society of Consulting Arborists and the International Society of Arboriculture, an instructor and research associate for the UC Davis Department of Environmental Horticulture, and an instructor and research horticulturist for the US Forest Service Center for Urban Forestry. His many years' experience with a wide variety of tree species and their growth responses under a variety of environmental conditions provide him with the necessary background for his role in the project.

### Schedule of Completion

[illegible]

## Project Budget Form Front

**SECTION 1: DETAILED BUDGET - CONSERVATION PROJECT SUPPORT**Name of Applicant UC Davis Arboretum

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

**SALARIES AND WAGES (PERMANENT STAFF)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
E.Zagory, Dir. of Hort. ( )		48 hrs. @ \$25.98		1,247	1,247
E.Griswold, Hort. Cur. ( )		240 hrs. @ \$16.86		4,046	4,046
Groundskeepers (10)		440 hrs. @ \$12.70		5,588	5,588
Administrative support (1)		48 hrs. @ \$19.88		954	954
<b>TOTAL SALARIES AND WAGES</b>			<b>\$</b>	<b>11,835</b>	<b>11,835</b>

**SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Student assistants (2)		500 hrs. @ \$9.50	4,750		4,750
( )					
( )					
( )					
<b>TOTAL SALARIES AND WAGES</b>			<b>\$ 4,750</b>		<b>4,750</b>

**FRINGE BENEFITS**

RATE	SALARY BASE	IMLS	MATCH	TOTAL
24	% of \$ 11,835		2,840	2,840
	% of \$			
	% of \$			
<b>TOTAL FRINGE BENEFITS</b>		<b>\$</b>	<b>2,840</b>	<b>2,840</b>

**CONSULTANT FEES**

NAME/TYPE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR HRS) ON PROJECT	IMLS	MATCH	TOTAL
John Lichter, consulting arborist					
-- specialty pruning	\$85/hr.	180	15,300		15,300
-- staff training	\$150/hr.	72	10,800		10,800
<b>TOTAL CONSULTATION FEES</b>			<b>\$ 26,100</b>		<b>26,100</b>

**TRAVEL**

FROM/TO	NUMBER OF: PERSONS DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	MATCH	TOTAL
	( ) ( )					
	( ) ( )					
	( ) ( )					
	( ) ( )					
<b>TOTAL TRAVEL COSTS</b>				<b>\$</b>		

## Project Budget Form Back

## SECTION 1 - CONSERVATION PROJECT SUPPORT-CONTINUED

## MATERIALS, SUPPLIES, AND EQUIPMENT

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Hard hats, eye protection	12 @ \$21.50	258		258
Saws	4 @ \$46.50 + 4 @ \$174 + 4 @ \$21	966		966
Loppers	4 @ \$94	376		376
Ladders	3 @ \$159	477		477
<b>TOTAL COST OF MATERIAL, SUPPLIES, &amp; EQUIPMENTS</b>		<b>2,077</b>		<b>2,077</b>

## SERVICES

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Irrigation construction	campus standard rates		28,518	28,518
Mulching	campus standard rates		16,880	16,880
Soil aeration	5 acres x 8 hrs./acre @ \$100/hr.	4,000		4,000
<b>TOTAL SERVICES</b>		<b>\$ 4,000</b>	<b>45,398</b>	<b>49,398</b>

## OTHER

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Copying and binding	15 @ \$20		300	300
<b>TOTAL COST OF OTHER</b>		<b>\$</b>	<b>300</b>	<b>300</b>

<b>TOTAL DIRECT PROJECT COSTS</b>	<b>\$ 36,927</b>	<b>60,373</b>	<b>97,300</b>
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**INDIRECT COSTS**

Check either A or B and complete C (see page 4.6 for an explanation of indirect costs).

- ☐ A. an indirect cost rate which does not exceed 20% of modified total direct costs – may be listed only as cost sharing and not to exceed \$10,000.
- ☒ B. Federally Negotiated Indirect Cost Rate (see page 4.6).

*Note: may be applied to both IMLS and match columns – total direct costs charged to IMLS even with a pre-negotiated indirect cost rate must not exceed \$50,000 or \$75,000 (if an exceptional project).*

Health & Human Services \_\_\_\_\_ in negotiation \_\_\_\_\_  
 Name of Federal Agency \_\_\_\_\_ Effective Date of Agreement \_\_\_\_\_

C. Rate	base(s)	Amount(s)	Amount(s)
27.5	% of \$	46,925	\$ 12,904
27.5	% of \$	74,831 (match)	\$ 20,579

<b>TOTAL INDIRECT COSTS</b>	<b>\$ 33,483</b>
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*Note: This page is part of the budget forms and must be included, whether or not you can claim an indirect cost rate.*

## Project Budget Form

**SECTION 3: SUMMARY BUDGET - CPS AND EDUCATION COMPONENT**Name of Applicant UC Davis Arboretum

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

<b>DIRECT COSTS</b>	<b>IMLS</b>	<b>MATCH</b>	<b>TOTAL</b>
SALARIES AND WAGES (PERMANENT STAFF)	<u>7,500</u>	<u>20,551</u>	<u>28,051</u>
SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)	<u>4,750</u>	<u>1,600</u>	<u>6,350</u>
FRINGE BENEFITS		<u>6,732</u>	<u>6,732</u>
CONSULTANT FEES	<u>26,100</u>		<u>26,100</u>
TRAVEL: DOMESTIC			
FOREIGN			
SUPPLIES & MATERIALS	<u>4,577</u>		<u>4,577</u>
SERVICES	<u>4,000</u>	<u>45,398</u>	<u>49,398</u>
OTHER		<u>550</u>	<u>550</u>
<b>TOTAL DIRECT COSTS</b>	<b>\$ <u>46,927</u></b>	<b>\$ <u>74,831</u></b>	<b>\$ <u>121,758</u></b>
<b>INDIRECT COSTS*</b>	<b>\$ <u>12,904</u></b>	<b>\$ <u>20,579</u></b>	<b>\$ <u>33,483</u></b>
			<b>\$ <u>155,241</u></b>
<b>AMOUNT OF CASH - MATCH</b>			<b>\$ <u>550</u></b>
<b>AMOUNT OF IN-KIND CONTRIBUTIONS - MATCH</b>			<b>\$ <u>94,860</u></b>
<b>TOTAL AMOUNT OF MATCH (CASH AND IN-KIND CONTRIBUTIONS)</b>			<b>\$ <u>95,410</u></b>
<b>AMOUNT REQUESTED FROM IMLS</b>			<b>\$ <u>59,831</u></b>
<b>PERCENTAGE OF TOTAL PROJECT COSTS REQUESTED FROM IMLS (MAY NOT EXCEED 50%)</b>			<b><u>39 %</u></b>

Have you received or requested funds for any of these project activities from another federal agency? (please check one) ☐ Yes ☒ No

If yes, name of agency \_\_\_\_\_  
Amount requested \$ \_\_\_\_\_

Date \_\_\_\_\_

## **Cincinnati Zoo and Botanical Garden**

Cincinnati, Ohio

Project Type: Research

IMLS Award: \$75,000

Match: \$173,904

Total Project: \$248,904

Museum Budget: \$19,246,632

## Application Narrative

### 1. What is the design of the project?

The proposed project will coordinate with 13 botanical gardens within the Center for Plant Conservation (CPC) network to develop and apply tissue culture propagation and preservation protocols for a selected group of highly endangered plant species that are in the CPC's National Collection of Endangered Plants (NCEP) and for which traditional methods of propagation are inadequate. The objectives of the project are to: 1) propagate and/or preserve the species using in vitro methods appropriate to the plant at the Cincinnati Zoo and Botanical Garden (CZBG)'s Center for Conservation and Research of Endangered Wildlife (CREW); 2) return propagated material to the CPC garden from which it came; and 3) preserve all tissue culture lines resulting from this project in cryostorage at CREW as a back-up, as designated in the CPC/CREW Cooperative Agreement (See Appendix A).

Within the framework of this design, there must be flexibility in the application of activities designed to achieve these objectives. Because of the great variety of species targeted for this work. There is great variation in the availability of tissues (due to seasonal, biological or human factors), the types of tissues needed (seeds, leaves, buds, etc.), and the responses of tissues to in vitro culture, acclimation and cryopreservation. As a result, the work on each species requires a unique approach and progresses at a different pace, even though all work is based on standard protocols (Appendix B).

A group of 40 species (Appendix C) that could benefit from in vitro research and which are in the NCEP has been identified for this project by CPC network garden staff. These include: 1) new species, and 2) previously targeted species. The latter include species at a variety of stages, with the normal progression being: acquisition of starting plant material, initiation of shoot cultures, rooting of shoot cultures, acclimation of plantlets, and cryopreservation of the tissue culture lines. Each species is categorized as to the next step needed in this progression, including: a) species for which propagation protocols are completed but for which cryopreservation protocols are needed or multiple genotypes require cryopreservation; b) propagated species for which acclimation protocols have not yet been successful; c) species with shoot propagation protocols, but for which rooting protocols need to be developed; d) species for which shoot propagation protocols have not yet been successful; e) species for which sufficient plant material has not been available; and f) species which have experienced particular problems in culture, including browning, callus production, or lack of rooting. Although there are a large number of species targeted for study, it is most efficient to have several species under study, since materials are not consistently available from each species and because tissue culture is a process which includes growing periods ranging from 1-6 weeks, during which work on other species can progress.

#### Project Activities

*Objective 1. Propagating and Preserving Targeted Species.* Project activities will focus on applying standard techniques, but for species not responding to these, alterations in the protocols will be made, based on an experimental approach and previous experience in this laboratory.

**Group 1. New Species.** Each species will be evaluated as to the tissues available for culture and the needs of that particular species. Standard protocols will be used (Appendix B) and specific methods that have been used on related species will be studied (Appendix D) to determine which are most likely to be successful, and work will begin on these. For example, for *Astragalus humillimus* and *A. montii*, procedures used previously in this lab with *A. cremnophylax* var. *cremnophylax* will be tested. Depending on the results, modifications of protocols or the application of new protocols will be made. A variety of approaches are available, as discussed below, depending on the tissue and the problem involved. This lab has experience in all of these standard in vitro propagation procedures, as well as in the modification of procedures to particular species.

**Procedures. Seed germination.** For species with some available seed, a portion will be used for in vitro germination, to obtain seedling tissue to establish shoot tip cultures (see below). Four species from Oregon, *Ivesia rhypara* var. *rhypara*, *Mentzelia mollis*, *Mentzelia packardiae*, *Sidalcea oregana* var. *calva*, as well as one from Utah, *Arctomecon humilis*, and three from Arizona, *Astragalus humillimus*, *Astragalus montii*, and *Ranunculus aestivus* have low germination rates, and in vitro germination will be used to try to utilize every seed that has potential for germination. In the case of the orchids, *Cypripedium kentuckiense* and *Tropidia polystachya*, work here with two other endangered orchid species, *Spiranthes delitescens* and *S. diluvialis*, has provided protocols for seed germination that will be tested. The germination of orchid seeds on nutrient medium in vitro is a standard procedure for orchid propagation, and seedling material can be used for shoot multiplication. **Embryo Germination.** When dormancy is suspected, embryos will be dissected from the seed for in vitro germination. This strategy has been successful in this lab with several rare species, including *Aster vialis* and *Primula maguirei*. **Somatic Embryogenesis.** In addition to seed germination, immature or mature embryos, or immature leaves or flowers, can be cultured, to stimulate somatic embryogenesis or shoot initiation. This strategy has been used in this lab with *Primula maguirei* and *Calamagrostis porteri* ssp. *insperata*. **Shoot Tip Culture.** Shoot tips from seedlings or from cuttings can be used to initiate shoot cultures. This has been successful in this lab with a number of endangered species, including *Aster vialis* and *Asimina tetramera*. When needed, shoot tips can be taken from plants in the wild using the technique of in vitro collecting (see below), and this has been successful for initiating cultures of *Rhexia aristosa*, *Lobelia boykinii*, *Shoenocrambe suffretescens*, *Aconitum noveboracense*, *Astragalus Cremonophalyx*, *Ziziphus celata*, *Hedeoma todsenii*, and *Clematis socialis*. **Young Leaf and Stem Culture.** Various plant hormones can stimulate young leaf and stem tissues of many species to produce shoot buds. These can then be used to initiate shoot cultures and produce plants, as has been done in this lab with *Trillium pusillum* var. *texanum*, *Asimina tetramera*, *Deeringothamnus rugelii* and *D. pulchellus*. **Rooting of Shoots.** Once shoots are obtained in vitro, they can be rooted on rooting media or as cuttings in sterile soil. **In Vitro Preservation Procedures.** For species with short-lived seeds, cryopreservation protocols will be applied to isolated embryo axes in vitro. Previous work in this laboratory has focused on drying and freezing excised embryos of largeseeded temperate trees, and this procedure will be applied to embryos of *Quercus hinckeyii* and *Castanea pumila* var. *ozarkensis*, when they are available.

**Group 2. Previously targeted species.** These species are at various stages in the process of developing propagation and preservation protocols. Some will be completed soon, while for others there has not been material available to use for developing protocols. They are categorized as to the next step needed. **A. Species for which propagation protocols are completed, but which require cryopreservation.** In the case of the *Deeringothamnus* spp., cryopreservation protocols are available, but there are multiple lines that require cryopreservation; in the case of *Isoetes louisianese*, cryopreservation protocols are in the process of being developed. **B. Species requiring acclimation protocols.** These are species which produce shoots and roots in culture, but which have proven difficult to acclimate. **C. Species for which rooting procedures are needed.** These are species for which shoot propagation protocols have recently been successful and for which rooting procedures are needed. **D. Species for which shoot propagation protocols are not yet completed.** In these cases, material has only recently been obtained and experiments are in progress to develop shoot propagation protocols. With *Mespilus canescens*, there has been significant progress in the past few months, as buds were developed on tissues acquired in the summer. These buds have not continued to grow out, but this is particularly encouraging, since previous work with this species resulted in callus only. E. For *Spiranthes delitescens*, *Pholisma sonorae*, *Ranunculus aestivalis*, and *Asplenium heterosiliens*, seed or spores have not been available, although there appears to be the possibility of obtaining material from each of these, at some point in the next year. **D. Species for which standard procedures have not been adequate.** Some species do not respond to standard protocols. Species in this group fall into three categories: 1) those which are difficult to root; 2) those which show extreme browning in vitro; 3) those which tend to grow as disorganized growth, or callus. Work in this laboratory is addressing all three of these problems, and has resulted in positive results with several species over the past two years. *Difficult-to-Root Species.* When species do not respond to the use of standard protocols of exposing the tissues to auxin, other approaches are taken. Success with the difficult-to-root *Asimina tetramera*, a previously targeted species, was achieved, after several years of testing various methods, by the use of silver thiosulphate (STS) in the rooting medium. STS inhibits the action of the plant hormone, ethylene, which can inhibit rooting. Cultures of *A. tetramera*, have now been successfully rooted on STS, and plants acclimated to soil. These procedures have also led to the successful rooting of the related *Deeringothamnus rugelii*. *Erythronium propullens* has been difficult to root, and similar experiments are underway with this species. In the next few months, a CREW post-doc will be hired to work in the Plant Research Division, and that person will focus on rooting in difficult-to-root species and improving rooting percentages in species with low rates of rooting. Their research will involve more extensive testing of various rooting stimulants, as well as an examination of the hormonal differences among these species. For example, ethylene will be measured, to look at its role in rooting, since we have used the ethylene inhibitor, STS, to successfully stimulate rooting. This research will be separate from the IMLS project and will be funded separately. It should, however, have a significant impact on the success of work with particularly difficult-to-root species within the CPC National Collection. *Species with Extreme Browning.* Three species proposed for this project, *Dicerandra immaculata*, *Dicerandra* 'Lake Pierce', and *Arctomecon humilis*, have shown a strong browning reaction to wounding or stress. This represents the oxidation of phenolic compounds, and is normal in many plants, but it can inhibit in vitro growth. Work with the previously targeted species, *Asimina tetramera* and *Agalinis navasotensis*, has shown that use of antioxidant chemicals, such as ascorbic acid and polyvinylpyrrolidone, combined with frequent transfers and controlling the size of the original explant, can result in successful establishment of cultures. Work will also focus on using *D. frutescens* and *D. thincicola*, two more common, related species to test various anti-browning techniques in order to develop protocols for the targeted species. *Callusing species.* In the case of *Castanea pumila* var. *ozarkensis*, despite the hormone treatments that have been tested thus far, shoot multiplication has not yet occurred; rather, growth has developed as disorganized or semi-organized callus. In the case of the *Dicerandra* spp., initial browning of the tissue inhibited the development of organized growth and allowed only callus growth. In such cases, the callus is being maintained and tested on various media, to try to stimulate the regeneration of shoot tissues, which has been documented in many plant species. Such shoots would then be used to initiate shoot multiplication cultures.

**Other Procedures. Acclimating Plants.** Moving plants from the high humidity of in vitro conditions to soil requires acclimation procedures which can involve media changes and manipulation of light, gases and humidity in the plant's environment. Plants are moved from the test tube to various types of soil under plastic domes on the lighted acclimation shelves in the CREW Plant Lab. *Aconitum noveboracense* should have plants ready for acclimation by spring of 2004. *Asclepias meadii* and *Agalinis navasotensis*, on the other hand, are species that have resisted acclimation, but which will be examined carefully in this proposed research. Different soils and humidity levels will be the first factors tested, whereas hardening pretreatments of the tissue in vitro with ABA, increased aeration, etc., will be tested next, as needed. Other factors will be tested with *A. navasotensis*, including changing the pH of the medium and the mineral composition to better conform to growth conditions on the Navasota sandstone outcrop, the only place where this plant is found. *In Vitro Collecting.* For sampling, the technique of *in vitro* collecting (IVC), or initiating tissues in the field, is used when appropriate. IVC has the advantage of utilizing very fresh tissues, of causing minimal disturbance to the plant in situ, and providing an efficient method of transporting samples back to the lab. IVC has been used with a number of previously targeted species, and in many cases has been done by our collaborators, using an IVC kit and instructions sent to them from this lab.

**Objective 2. Return of Plants to the Collaborating Garden.** Once plants are acclimated, they will be returned to the garden from which the starting material came. In some cases, plants are returned to the garden in vitro for acclimation there in a more suitable habitat. Plants of 18 previously targeted species have been or soon will be returned to collaborating gardens.

**Objective 3. Preservation of Tissue Culture Lines.** Several cryopreservation protocols are used in this laboratory. Encapsulation dehydration and encapsulation vitrification have been the most successful, and these are tried first with each tissue line. If survival is not adequate, other procedures, including slow, two-step freezing and vitrification are

available in this lab for testing. Tissues of 20 genetic lines of 9 previously targeted species have been banked for long-term storage in liquid nitrogen in CREW's Frozen Garden with 7 more currently being propagated for cryopreservation. *Genetic Sampling*. Tissue culture lines are initiated from as many individuals as are available to represent as much of the genetic diversity of the species as possible for cryopreservation and long-term storage of this material. Tissue culture lines and plants generated from these samples are maintained as separate genotypes. Multiple lines are in hand of *Deeringothamnus rugelii*, and *D. pulchellus* and these are being cryopreserved.

**Staff.** With the support of the IMLS, one full-time Research Associate, Susi Charls, will be hired to work on in vitro propagation and cryopreservation of the targeted plant species at CREW. Dr. Pence will devote 35% of her time to working on the design and implementation of protocols for each of the species, as well. In addition, CREW Research Associate, Bernadette Plair, will devote 30% of her time to the cryopreservation aspects of the project. Four part-time lab assistants will spend 60% of their collective time in support work, maintaining the greenhouse and culture collections and assisting in cryopreservation protocols, while another Lab Assistant/dishwasher will devote 20% time to this project. Volunteer lab assistants will devote 60% of their time to media making and other support procedures. The staff at the collaborating CPC gardens (Appendix C) will be responsible for collecting and shipping plant materials and for providing background information on the species. Dr. Kathryn Kennedy at the CPC will assist in coordinating activities with the gardens, in maintaining the National Collection, and in disseminating information on the CPC website.

**Schedule and Products.** The number of species proposed here is slightly higher than that included in the previous IMLS proposal, because: 1) of experience gained in that previous work; 2) two of the new species are congeners and 5 others are in the same families of previously targeted species with established procedures; 3) four genera have more than one species targeted and should require similar procedures; and 4) four of the species have not been available, but are included should material become available. The availability of material can never be predicted with certainty, since it is affected by weather, natural disasters (e.g. floods), and the unpredictability of the appearance of particular species from year to year (as with some orchids). Some species from previously funded work are included in this proposal, since either plant material only recently became available, or the species pose particular challenges to tissue culture, as noted above. Based on our previous work, the number of species is appropriate for the schedule of time and the personnel included within this proposal.

The results of these studies will be written into one or more papers for scientific publication in journals such as *In Vitro Cellular and Developmental Biology-Plant*; *Micropropagation News*; *Plant Cell Tissue and Organ Culture*; and *Plant Cell Reports*, and will be presented at least one meeting of the Society for In Vitro Biology. Information will also be disseminated to other CPC gardens through the CPC newsletter and to the CZBG community through its publication, *Wildlife Explorer* and the CREW newsletter, *CREW Review*. (See Appendix E for presentations and publications thus far on IMLS funded work.) An exciting new avenue for dissemination is the CPC website, which is being developed as an exhaustive resource for information on endangered plant species in the NCEP (see Appendix F).

## **2a. What are the proposed conservation methods and why are they conservationally sound?**

In vitro methods are being proposed for the 40 selected species in order to revive populations of these species for which traditional methods of propagation and preservation are not adequate. There is a large body of tissue culture literature to draw upon in designing specific protocols for the treatment of the plant material (see Appendix D). A collection of bibliographic information (currently >26,000 references) and a growing library of articles on plant tissue culture are maintained at CREW as the Plant Tissue Culture Database, and these provide the PRD with efficient access to this information, in addition to access to near-by university libraries and other on-line databases. By adapting procedures used with related or similar species, the most efficient use of resources will be made, and the possibility of success with these species will be maximized.

The reliability of these methods is demonstrated in the many endangered and nonendangered plant species that have been propagated worldwide using in vitro techniques over the past 25 years. However, each species is unique and some require study and adaptation of standard protocols to fit their particular needs. The PCD has broad experience in the application of these protocols, as well as in the development of new and innovative methods, such as embryo axis freezing and in vitro collecting, for plant propagation and germplasm preservation in vitro.

Two areas require particular attention when dealing with endangered taxa. Because tissue culture propagation is a clonal process, *maximizing genetic diversity* by seed or embryo germination will be of highest priority. *Each one* of the seeds or plants sampled will then be propagated. These lines will be maintained separately, and the resulting population of plants will reflect the *same* genetic diversity as the original seedling or plant population, but the potential will exist for producing more than one plant of each type. The occurrence of *somaclonal variation*, or genetic changes, can also occur during tissue culture. Since propagation from previously formed buds appears to present the lowest probability of somaclonal variation, preference will be given to that method. Regeneration of buds from other tissues will be used when buds are not available, and in all cases, propagated plants will be evaluated for their phenotypic trueness-to-type.

Laboratory safety is of the highest priority in the CREW labs, and compliance with best practice and OSHA safety standards is required.

## **3. What is the object(s), historic structure(s), or specimen(s) that is the focus of the project?**

All of the proposed species are of very limited range. In addition, they have problems in reproduction, or, in a few cases, in germplasm storage, and/or they are in need of assistance in building up their numbers in the NCEP. They represent the 'critical cases' within the CPC National Collection. Specifically, *Spiranthes delitescens* and *Cypripedium kentuckiense* are rare orchids and require in vitro methods for seed germination; *Pholisma sonora* is a sand dune endemic threatened by habitat loss; *Ranunculus aestevilis* is known from only two, small fluctuating populations; *Arctomecon humilis*

is known from only one county and seed cannot be germinated; *Deeringothamnus pulchellus* and *Lupinus aridorum* are rare and set few seeds, and the latter is susceptible to disease in the wild; *Astagalis cremnophylax* var. *cremnophylax* has low seed set in the wild; *Purshia subintegra* is known from only 4 sites and is very slow to propagate by cuttings; *Erythronium propullens* and *Zanthoxylum parvum* have very limited ranges and produce no seed; *Primula magueri* is found on steep cliffs and is at risk from climbers and road construction, and seed cannot be germinated; *Asclepias meadii* is a rare prairie species which has suffered from habitat loss, and some populations produce no seed; *Isoetes louisianensis*, *I. tegetiformans*, and the *Dicerandra* species are known from only a few sites and require methods for germplasm preservation; *Agalinis navasotensis* and *Licaria triandra* are each only known from 1 site in the wild; *Aconitum noveboracense* is declining due to habitat degradation; *Asplenium heterosiliens* is rare and threatened by habitat loss and invasive species; *Ziziphus celata*, known from only 3 sites, requires an increase in numbers to maintain populations as well as for phytochemical testing; *Mespilus canescens* is known from only 1 site with 25 individuals and is slow to propagate in captivity; *Tropidia polystachya* is known from only 2 sites with fewer than 12 individuals; *Quercus hinckleyi* and *Castanea pumila* var. *ozarkensis* have seeds which cannot be stored long-term, and the latter is susceptible to chestnut blight; *Fryxellia pygmaea* is rare and difficult to propagate; *Argemone pleiacantha* ssp. *pinnatisecta* is rare with declining numbers; *Asagalas humillimus* and *A. montii* are rare with habitat threats and require supplemental material for ex situ research; and *Ivesia rhypara* var. *rhypara*, *Mentzelia mollis*, *M. packardiae*, *Sidalcea oregana* var. *calva*, *Cimicifuga arizonica*, and *Cyclademia humilis* var. *jonesii* are rare species with seeds that are very difficult to germinate.

Each of these is a unique species with importance as part of its natural habitat and of importance as a species for potential utilization by humankind. Species of *Ziziphus* have been used in traditional and western medicine. Biologically active chemicals from species in the Annonaceae, Saxifragaceae, and Papaveraceae have been studied extensively, while species within the Ranunculaceae are also known to produce alkaloids and other biologically active compounds. Members of the Brassicaceae have been shown to contain anti-carcinogenic compounds. Species of the Lamiaceae (mint family) are well known for their volatile oils, flavorings and scents, while members of the Orchidaceae, Asclepiadaceae, Isoetaceae, Liliaceae, Primulaceae, Rosaceae, and Ranunculaceae are horticulturally important as ornamentals. The potential for the usefulness of wild species is not always known, but if these rare taxa are lost, it will be impossible to evaluate what they may have to offer humankind. Many of them are congeners with economically important species (Phillips and Meilleur, 1998) or species used in traditional medicine (Duke 2002).

Founded in 1984, the CPC is the only organization in the U.S. whose purpose is to prevent the extinction of native plants. The CPC is a consortium of thirty-four botanical gardens and arboreta nationwide that collectively maintain endangered plants in the NCEP, which currently includes nearly 600 species, making it one of the largest conservation collections in the world. The CPC's mission is to create a systematic, comprehensive national program of plant conservation, research and education.

The Cincinnati Zoo and Botanical Garden's mission is, simply, *Adventure, Conservation, Education*. The institution is committed to the understanding and preservation of wild animals and plants and our living world through naturalistic exhibits of animals and plants, scientific research, education, and active cooperation with a worldwide network of conservation organizations. The CZBG is home to the largest botanical garden in the region, which features one of the most extensive collections of perennials, flowering trees and shrubs in the nation. Currently, there are more than 2000 species of plants represented in the CZBG collection.

The CZBG's dedication to conservation science is displayed in its world-renowned research division, CREW. Established in 1981, CREW's mission is to use science and technology to understand, preserve, and propagate endangered flora and fauna and to facilitate the conservation of global biodiversity. The propagation and preservation of endangered plant species is aided through the application of tissue culture propagation, in vitro collecting, and cryopreservation of seeds, embryos, shoot tips, spores, gametophytes, pollen and cell cultures. CREW's Frozen Garden and Frozen Zoo are collections of a wide variety of rare plant and animal germplasm stored in liquid nitrogen, providing a "back-up" of genetic material for future use.

In the true spirit of their missions, the CZBG's CREW and the CPC and its member gardens are collaborating to enhance the propagation of highly endangered species in the National Collection of Endangered Plants. The proposed research will not only work to preserve the 40 species listed, but will act as a model for the preservation of other highly endangered plant species. Working in cooperation with 13 botanical gardens geographically dispersed throughout the U.S., the CPC and CREW researchers have targeted these species because of their rarity and uniqueness. The preservation of these species will have both local and national impact as each species is endemic to the habitat in which its participating garden is located and each species is part of the National Collection of Endangered Plants.

#### 4. How does the project relate to your museum's ongoing conservation activities?

A central focus of CREW research is found in its Plant Research Division (PRO), which was established in 1987 to adapt the biotechnologies of plant science to the preservation of rare and endangered plants. Over the last 16 years, the PRO has made significant strides in its Endangered Plant Propagation Program (EPPP), developing tissue culture techniques for those species that are experiencing reproductive difficulties, as well as developing in vitro collecting and cryopreservation protocols for the collecting and long-term storage of rare species.

PRO researchers were the first to culture various species of *Trillium*, including the rare *Trillium persistens* (Pence and Soukup, 1995). Since then, IMLS-EP funding has supported work on over 50 of this country's most endangered species (see Appendix G for summary and more details). *Aster vialis*, *Sisyrinchium sarmentosum*, *Calamagrostis porteri* ssp. *insperata*, *Lobelia boykinii*, *Rhexia aristosa*, *Arenaria cumberlandensis*, *Crotalaria avonensis*, *Spiranthes deluvialis*, *Asimina tetramera*; *Clematis socialis*; *Hedeoma todsenii*, *Trillium pusillum* var. *texanum*; *Sagittaria fasciculata*; and *Hedyotis purpurea* var. *montana* have all been successfully propagated in vitro, and the tissues have been or are in the process of being

cryopreserved for long-term maintenance in CREW's Frozen Garden. Plants of these species have been or are being returned to the collaborating gardens. Several other species, included in this proposal, are close to being completed: *Aconitum noveboracense*, *Agalinis navasotensis*, and *Astragalus cremnophylax* var. *cremnophylax*. Work with another target species, *Plantago cordata*, indicated that the seeds, while short-lived in nature, could withstand drying and cryopreservation. They are now being maintained in the Frozen Garden at CREW. Other rare, non-IMLS funded species have been propagated in the lab, including: *Hexastylis shuttleworthii*, *Ulmus thomasii*, *Trillium persistens* and *Brunfelsia densifolia*.

The species chosen for this work from the National Collection are, by definition, critically endangered. They are also those for which traditional propagation methods have proven unsuccessful or inadequate to meet the conservation needs of the species and they are thus of highest priority for this research.

Other related conservation research in the PRD includes the in vitro propagation and cryopreservation of nonseed plants (pteridophytes and bryophytes) and the seed banking of species that are regionally threatened. A previous IMS-CP grant enabled the PRD to accelerate the development of optimal long-term storage methods for threatened and endangered plant species native to Ohio. The PRD also supports basic research on the hormonal basis for plant growth in vitro, factors affecting hyperhydricity in vitro, factors affecting browning in vitro, the physiology of desiccation tolerance, critical to seed storage protocols, and the chemical basis of disease resistance, particularly resistance to the chestnut blight which has decimated the American chestnut population. Ongoing work is also directed at improving the technique of in vitro collecting.

## **5. What are the anticipated benefits of this project?**

The role of scientific discovery increases as zoos, botanical gardens, and arboreta continue their evolution from recreation centers to centers for conservation. The proposed research will benefit these museums by first, providing a reserve of genetic material in both the living collections of the participating CPC gardens as well as in liquid nitrogen storage in the Frozen Garden at CREW. This material can be used for ex situ conservation, research, display, education, and reintroduction.

This research will also provide baseline information for application to the many similarly endangered and reproductively disturbed plant species found in collections throughout the world. Just as PRD researchers are using past research as a basis for developing protocols for work with new species, it is anticipated that other researchers will use the results of this project as a basis for further studies. Plant tissue culture is still largely an empirical science, and the information gained from each project increases researchers' collective knowledge of the role that tissue culture propagation can play in enhancing the reproduction of endangered plant species.

Research results will be shared with other institutions through publications in peer-reviewed journals and presentations at professional meetings (Appendix E), and as part of the CPC website (Appendix F). While the CPC website currently is a resource for information on the plants in the National Collection, a future goal is that researchers interested in the propagation of a particular species will be able to easily access any available propagation information on that species, including the protocols developed in this proposal. The research proposed here has the support of each participating garden, as well as of the CPC (see Letters of Support). Therefore, the CPC and its participating gardens will be informed of the progress of the research throughout the duration of the project.

Work funded by IMLS currently and in the past for this project has resulted in a number of other benefits for these species, and it is expected that that process will continue for the work in this proposal (see "Protocol Benefits" in "Progress Report", Appendix G). These benefits include the use of the protocols developed in IMLS funded projects to be used in other projects, not funded by IMLS, such as for the planned reintroduction of *Crotalaria avonensis* in Florida and *Arenaria cumberlandensis* in Kentucky. Plants produced in vitro have been used to develop a naturalistic display at the CZBG of *A. cumberlandensis*, with signage describing its endangered status and conservation work on it and similar plants. For species with recalcitrant seeds, such as *Asimina tetramera*, *Deeringothamnus rugelii*, *Deeringothamnus pulchellus*, and *Sagittaria fasciculata*, the development of propagation and, particularly, cryopreservation procedures provides the only known method for long-term ex situ storage of genetic material of these species. This is a huge benefit to the species and provides a model for dealing with other species with recalcitrant seeds. Finally, work is ongoing to acquire funding for projects that can go beyond the IMLS funded work in utilizing the plant material and the protocols developed with IMLS funding. This is particularly centered on developing collaborative projects with U.S. Fish and Wildlife offices dealing with each of the species (one such proposal has been submitted to the Jacksonville, FL, office to deal with the reintroduction of *Lupinus aridorum*), but has also included the acquisition of grants from private agencies, such as the Association of Zoological Horticulture, which recently awarded the PRD \$2000 for work on preparing plants of *Asimina tetramera* for reintroduction. Future efforts will also include seeking funding for the production large numbers of several of these endangered species for pharmaceutical testing.

The *raison d'être* of both the CPC and CREW is conservation, and thus, their entire budgets are dedicated to that end. CREW comprises approximately 5% of the entire CZBG budget, which also includes substantial conservation education activities.

## **6. How will the applicant ensure that ongoing museum functions are not inhibited by these project activities?**

CREW has occupied its state-of-the-art facility for more than 13 years. This facility was constructed solely for research and education; therefore, new projects are undertaken on a regular basis without disrupting the Zoo and Botanical Garden's general operations. CREW grant monies are maintained separately from general funds and are closely monitored by CREW Principal Investigators and the Zoo Comptroller. Monies awarded from this Exceptional Project will be similarly monitored to ensure that funds are expended for purposes designated in the project budget. General

operating support is generated through a combination of CZBG operating support and CREW fund raising, grants and earned income. These funds will be used to match IMLS grant monies. The hiring of a Research Associate dedicated solely to this project will enable CREW's PRD to conduct this research without inhibiting other division functions.

## **7. How does the project budget support the project goals and objectives?**

The budget for the proposed project was developed based upon a number of factors. The intensive research dedicated to this project requires a full-time Research Assistant. Additionally, the following are included in order to accomplish the goals of this project: A portion of Dr. Pence's time to closely direct and implement the project goals; a portion of the time of one PRD Research Associate for cryopreservation work and of lab assistants (salaried and volunteer) for media making, routine transfers, and greenhouse and lab support; a portion of the time of Dr. Kathryn Kennedy for maintaining the National Collection and coordination of the CPC gardens; and a portion of the time of the collaborating gardens staff for collecting and sending plant material to CREW. In addition, the project requires consumable supplies, including media, hormones, antibiotics, petri plates, culture tubes and caps, greenhouse supplies, etc. For dissemination of the results of this study, travel to one meeting of the Society for In Vitro Biology is included.

The request to IMLS is for \$75,000 which is 30% of the total budget for completion of this project. IMLS funds will be used to underwrite the salary and fringe benefits of a full-time Research Assistant for two years; a portion of Dr. Kennedy's salary; a portion of the garden staff salaries; travel to one meeting; and a portion of the supplies.

## **8. What are the qualifications of the project personnel?**

**Valerie C. Pence, Ph.D., Director of Plant Research Cincinnati Zoo and Botanical Garden, Center for Conservation and Research of Endangered Wildlife.** Dr. Pence earned her Ph.D. in Plant Physiology from Northwestern University and conducted Postdoctoral research at Purdue University and the University of Florida. As the Director of the Plant Research Division of CREW since its formation in 1986, she is a leader in the development of technologies for the preservation and propagation of rare and endangered plant species and in the technique of in vitro collecting. All of her doctoral and post-doctoral research has involved in vitro systems. In addition to her position at CREW, Dr. Pence is an Adjunct Research Associate Professor in the Department of Biological Sciences at the University of Cincinnati. As a member of the Scientific Advisory Council of the Center for Plant Conservation (CPC), she provides scientific guidance for the preservation and propagation of the species held as part of the organization's National Collection of Endangered Plants. Dr. Pence will direct the project and work closely with the Research Associate and other CREW staff to design and modify protocols for each of the species, monitor their progress, and analyze and disseminate the results of this work.

**Kathryn Kennedy, Ph.D., President and Executive Director, Center of Plant Conservation, Missouri Botanical Garden.** Dr. Kennedy received her Ph.D. from the University of Nebraska in systematics. She has held a number of positions in the areas of field botany and plant ecology, and has experience with non-profit as well as state and governmental agencies dealing with plant conservation. As the President and Executive Director and former Scientific Advisor of the CPC, she has extensive experience with and knowledge of plant conservation. She is in direct contact with the staffs and collections of the thirty-four CPC botanical gardens and arboreta throughout the United States, and therefore is well-positioned to form collaborations for the preservation of endangered plant species. Dr. Kennedy will review the results of the research and advise on aspects of the conservation strategies for the species being addressed through this project.

**Full-time Research Assistant, Susan Charls.** Ms. Susan Charls is working on the propagation of the endangered species under the current IMLS funding. Ms. Charls received a B.S. in Biological Sciences from the College of Mount St. Joseph in 1996. Prior to that time she spent 1.5 years as a co-operative education student working in the CREW PRD and worked as a volunteer in the lab during subsequent summers. As a result, she has gained experience and expertise in several types of tissue culture and in other related techniques. She began work as a PRD Research Assistant in September, 2001. Her responsibilities are centered on the plants included in the IMLS project, to which she will devote 100% of her time.

**CREW Research Associate, Bernadette Plair.** Ms. Bernadette Plair, CREW PRD Research Associate will assist with this project with 30% of her time. Ms. Plair has developed significant expertise with a number of cryopreservation procedures and has worked extensively with the cryopreservation of a variety of plant tissues, including IMLS funded taxa. She has also worked with the in vitro collecting project in the PRD. She completed her Masters' Degree from the Department of Biological Sciences at the University of Cincinnati in the summer of 1998.

**Laboratory Assistants.** Several workers will fill this position part-time, including five salaried workers (one as a dishwasher) and several volunteers who work in the PRD on a regular basis. These LAs routinely make tissue culture media, make routine tissue culture transfers, assist in greenhouse work and wash glassware.

## SCHEDULE OF COMPLETION

MAY 2004 – APRIL 2006

	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
Initiate cultures and/or attempt seed, spore or embryo germination from all species as the materials become available through the season.																								
Grow tissue culture lines.																								
Alter media if necessary for shoot and embryo initiation.																								
Root and acclimate plants.																								
Experiment with cryopreservation of the culture lines.																								
Repeat any collections, as needed.																								
Do broad-based sampling of germplasm for those species requiring vegetative propagation.																								
Grow tissue culture lines from sampled material.																								
Return plants to CPC gardens.																								

## Project Budget Form Front

**SECTION 1: DETAILED BUDGET - CONSERVATION PROJECT SUPPORT**Name of Applicant Cincinnati Zoo and Botanical Garden

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

**SALARIES AND WAGES (PERMANENT STAFF)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<u>[REDACTED]</u>	(1)	35%time x <u>[REDACTED]</u> x 2 yrs		39,200 ✓	39,200 ✓
<u>[REDACTED]</u>	(1)	30%time x <u>[REDACTED]</u> x 2 yrs		22,800 ✓	22,800 ✓
<u>[REDACTED]</u>	(1)	1%time x <u>[REDACTED]</u> x 2 yrs	960	960	1920 ✓
CPC Garden Reps	(1)	0.6%time x 35,000 x 2 yrs x 40 speci ✓	8400	8400	16800
<b>TOTAL SALARIES AND WAGES</b>			<b>\$ 9360</b>	<b>71,360 ✓</b>	<b>80,720 ✓</b>

**SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<u>[REDACTED]</u>	(1)	100%time x <u>[REDACTED]</u> x 2 yrs	48,000 ✓	1,600 ✓	49,600 ✓
Lab Assistant	(4)	60% time x 15,600 x 2 yrs		18,720 ✓	18,720 ✓
Lab Asst/Dishwasher	(1)	20%time x 15,600 x 2 yrs		6240 ✓	6240 ✓
	( )				
<b>TOTAL SALARIES AND WAGES</b>			<b>\$ 48,000 ✓</b>	<b>26,560 ✓</b>	<b>74,560 ✓</b>

**FRINGE BENEFITS**

RATE	SALARY BASE	IMLS	MATCH	TOTAL
30	% of \$ 130,320 ✓	14,400	24,696	39,096
15	% of \$		3744	3744
	% of \$			
<b>TOTAL FRINGE BENEFITS</b>		<b>\$ 14,400</b>	<b>28,440</b>	<b>42,840</b>

**CONSULTANT FEES**

NAME/TYPE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR HRS) ON PROJECT	IMLS	MATCH	TOTAL
None					
<b>TOTAL CONSULTATION FEES</b>			<b>\$</b>		

**TRAVEL**

FROM/TO	NUMBER OF: PERSONS DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	MATCH	TOTAL
Cincinnati/Society	(1) (4)	900	400	1300		1300
for In Vitro Biology	( ) ( )					
Meeting (location	( ) ( )					
TBA) 2005	( ) ( )					
<b>TOTAL TRAVEL COSTS</b>				<b>\$ 1300 ✓</b>		<b>1300 ✓</b>

## Project Budget Form Back

**SECTION 1 - CONSERVATION PROJECT SUPPORT-CONTINUED****MATERIALS, SUPPLIES, AND EQUIPMENT**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Culture media/ petri dishes,	4,000/yr x 2 yrs	1940	6060	8,000
culture tubes, consumable				
supplies				
<b>TOTAL COST OF MATERIALS, SUPPLIES, &amp; EQUIPMENTS</b>		1940	6060	8,000

**SERVICES**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
None				
<b>TOTAL SERVICES</b>		\$		

**OTHER**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
None				
<b>TOTAL COST OF OTHER</b>		\$		

<b>TOTAL DIRECT PROJECT COSTS</b>	<b>\$</b>	75,000	132,420	207,420
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**INDIRECT COSTS**

Check either A or B and complete C (see page 4.6 for an explanation of indirect costs).

- ☒ A. an indirect cost rate which does not exceed 20% of modified total direct costs – may be listed only as cost sharing and not to exceed \$10,000.
- ☐ B. Federally Negotiated Indirect Cost Rate (see page 4.6).

*Note: may be applied to both IMLS and match columns – total direct costs charged to IMLS even with a pre-negotiated indirect cost rate must not exceed \$50,000 or \$75,000 (if an exceptional project).*

\_\_\_\_\_  
Name of Federal Agency

\_\_\_\_\_  
Effective Date of Agreement

C. Rate	base(s)	Amount(s)
20	% of \$	207,420
	% of \$	

Amount(s)
\$ 10,000
\$

<b>TOTAL INDIRECT COSTS</b> \$ 10,000
---------------------------------------

*Note: This page is part of the budget forms and must be included, whether or not you can claim an indirect cost rate.*

# Project Budget Form

### SECTION 3: SUMMARY BUDGET-CPS AND EDUCATION COMPONENT

Name of Applicant Cincinnati Zoo and Botanical Garden

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

DIRECT COSTS	IMLS	MATCH	TOTAL
SALARIES AND WAGES (PERMANENT STAFF)	9,360 ✓	71,360 ✓	80,720 ✓
SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)	48,000 ✓	26,560 ✓	74,560 ✓
FRINGE BENEFITS	14,400 ?	28,440 ?	42,840 ?
CONSULTANT FEES			
TRAVEL: DOMESTIC	1300 ✓		1300 ✓
FOREIGN			
SUPPLIES & MATERIALS	1940 ✓	6060 ✓	8,000 ✓
SERVICES			
OTHER			
<b>TOTAL DIRECT COSTS</b>	<b>\$ 75,000 ✓</b>	<b>\$ 132,420 ✓</b>	<b>\$ 207,420 ✓</b>
<b>INDIRECT COSTS*</b>	<b>\$</b>	<b>\$ 10,000</b>	<b>\$ 10,000</b>
* If you do not have a current Federally Negotiated Rate, your indirect costs must appear in the Match column only.			
	<b>TOTAL PROJECT COSTS</b>	<b>\$ 217,240</b>	
<b>AMOUNT OF CASH - MATCH</b>		<b>\$ 132,420</b>	
<b>AMOUNT OF IN-KIND CONTRIBUTIONS - MATCH</b>		<b>\$ 10,000</b>	
<b>TOTAL AMOUNT OF MATCH (CASH AND IN-KIND CONTRIBUTIONS)</b>		<b>\$ 142,420</b>	
<b>AMOUNT REQUESTED FROM IMLS</b>		<b>\$ 75,000</b>	
<b>PERCENTAGE OF TOTAL PROJECT COSTS REQUESTED FROM IMLS (MAY NOT EXCEED 50%)</b>			<b>35%</b>

Have you received or requested funds for any of these project activities from another federal agency? (please check one) ☐ Yes ☐ No

If yes, name of agency \_\_\_\_\_  
Amount requested \$ \_\_\_\_\_

Date \_\_\_\_\_

## **Toledo Zoo**

Toledo, Ohio

Project Type: Research

IMLS Award: \$55,759 (includes \$9,607 for education component)

Match: \$98,754

Total Project: \$154,513

Museum Budget: \$22,383,141

## 1. WHAT IS THE DESIGN OF THE PROJECT?

Our project will focus on the development of husbandry and breeding techniques that can be used for three endangered butterfly species: the Mitchell's satyr, *Neonympha mitchellii*, the purplish copper, *Lycaena helloides*, and the swamp metalmark, *Calephelis muticum* (WBI butterflies). Our goals are to: 1. Develop horticultural techniques for maintenance of the smartweed, *Polygonum amphibium*, the tussock sedge, *Carex stricta*, and the swamp thistles *Cirsium muticum* and/or *C. altissimum*, in a greenhouse setting. These are the host plants for our WBI butterflies. 2. Collect winter temperature (T) and relative humidity (RH) data at wetland butterfly over-wintering sites. 3. Develop the methodology to reproduce conditions of over-wintering WBI larvae *ex situ*. 4. Determine rearing techniques for WBI butterflies that balance optimal survival with high larva production. 5. Develop conservation breeding techniques for adult WBI butterflies.

Experimental design, set-up, and project supervision will be the primary responsibility of Peter J. Tolson, PhD., Director of Conservation for The Toledo Zoo (TTZ). Tolson will devote 15 % of his total work effort/yr. specifically to this project; a total 30 % of work effort/yr. will be devoted to WBI butterfly activities for the duration of the project. Aiding in the project will be Mitchell L. Magdich, B.S., Curator of Education for the TZG. Magdich will aid in supervision and implementation of this project, especially when Tolson is not present. Magdich will devote 5 % of his total work effort/yr. specifically to this project; a total of 10 % of work effort/yr. will be devoted to butterfly activities over the duration of the project. A Research Technician hired for the project, Candee L. Ellsworth, B.A. will be responsible for maintenance and manipulation of experimental and control group WBI butterflies and eggs as well as care of host plants. She will devote 50% of total work effort/yr. specifically to this project. An additional 50% of work effort/ yr. will be devoted to other WBI recovery activities over the duration of the project. Ellsworth will carry out all experimental tasks under the supervision of Tolson and Magdich, who will aid with activities as needed. Two full-time summer research fellows with tenure under the Zoo's Roger Conant Fellowship program will provide additional assistance.

**Task 1. Develop horticultural techniques for maintenance of *Polygonum amphibium*, *Carex stricta*, and *Cirsium muticum* and/ or *C. altissimum* in a greenhouse setting.** Data on soil composition, seasonal saturation, and pH will be collected in the wild for the host plants at Toledo Express Airport, the Irwin Prairie State Nature Preserve (*Polygonum*), the Barry County State Game Area near Hastings, MI (*Carex*), and Cedar Bog near Urbana, OH (*Cirsium*). Soil organic composition (%) will be determined by use of a soil analysis field test kit. Soil texture (% sand, silt, clay) will be analyzed using a soil texture unit. Soil pH will be determined by a field pH meter with probe. Seasonal soil saturation will be determined with a soil moisture meter. See Clarke (1). These parameters will be used in the custom design of a soil mix for each of the host plant species. These **data will be collected concurrently with data from task 2**. Initial soil sampling (all parameters) will occur in May 2004. Saturation sampling will occur at 3- month intervals in May, August, November 2004, and March 2005. These data will be collected by Tolson, Ellsworth, and Magdich from the field sites and will require one day in the field at each site for 2 persons for three visits in 2004 and one visit in 2005. Additionally, we will increase polyhouse temperatures to ca. 10°F above ambient in the polyhouse in April-May 2004-05 to attempt to increase germination and growth of cultivated host plants. We will use a 240,000 BTU forced-air greenhouse heater to prevent early frost and give host plants a head start over their wild counterparts. Dates of germination and rate of growth in cm/week of cultivated plants under heat will be compared to plants at the field sites.

**Task 2. Collection of winter environmental data at wetland butterfly oviposition and overwintering sites.** We will spend two days at each collecting locality searching for over-wintering larvae in early May and late Oct. 2004. However, searching will continue until larvae of each target species are found. Butterfly species differ in the life stages and site selections for overwintering, so these data will be collected at different sites for each species. Over-wintering sites will be discovered by careful searches of plant material and sub-soil in areas populated by late instar larvae of WBI target species at Toledo Express Airport (*Lycaena*), the Barry County State Game Area near Hastings, MI (*Neonympha*, *Satyrodes*), and Cedar Bog (*Calephelis*). Host, nectar, and support plant density and frequency will be quantified by counting individual stems of host and associated herbaceous plants within a 0.5 x 1.0 m quadrat using the methodology of Bonham (2). Stowaway® 32K data loggers will be programmed to record T and RH at duff, soil,

or plant level at 30-min. intervals. Data will be collected continuously from early May 2004 to late April 2005, downloaded monthly, and used as starting values for T and RH over-wintering in task 5. This is critical information, as larval winter mortality accounts for the highest death rate during the life cycle (3). This activity will require one round trip of 420 mi./month to the BSGA, one round trip of 44 mi./month to Toledo Express Airport, and one round trip of 224 mi./month to Cedar Bog from May 2004 through April 2005. As this task requires travel from the Zoo, Tolson, Magdich and Ellsworth will share responsibility for this task.

**Task 3: Determine optimal larval rearing strategies for WBI target butterflies that balance survival with high larval production.** In this task we will test rearing enclosures that accommodate the high mobility of WBI larvae and methods to maximize their food resources. Enclosures will provide for their safety (especially from drowning) in the semi-aquatic environment necessary for their host plants. Optimal use of host plant resources is particularly important in multiple brooded butterflies such as *Lycaena*, which have the ability to rapidly outstrip food supplies in captivity. In this task, the northern eyed brown, *Satyrodes euridice*, will be used as a surrogate for Mitchell's satyr until techniques are perfected. We will continue to use techniques to enhance larval survival used successfully in our work with the Kamber blue butterfly (KBB), e.g. fertilization of host plants, use of a misting system, etc (4).

**Experiment 1- rearing containers.** After hatching, larvae will be placed on host plants at densities of 10 larvae/ host plant and will be transferred to a new plant when a particular host plant becomes denuded. *Lycaena* and *Calephelis* larvae will be raised under two experimental regimes. In the first trial, 10 groups of 10 larvae will be placed on *polygonum* (*Lycaena*) or *Cirsium* (*Calephelis*) rooted in a saturated sand/ peat mixture (determined from task 1) in a 2 gallon pot and covered with polyester netting. In the second trial, larvae will be placed at the same spatial density and soil mixture as trial 1, but will be raised in ten 30 x 60 cm polyethylene tubs covered with polyester netting- to determine if the ability for greater movement and host plant selection will reduce/ deter attempts to escape the rearing enclosure. *Neonympha* and *Satyrodes* larvae, because of their large size, will be raised in larger enclosures. In the first experimental trial, 10 groups of 10 larvae will be placed on *Carex* rooted in a saturated sand/ peat mixture (determined from task 1) in a 29-gallon pot and covered with polyester netting. In the 2nd trial, 100 larvae will be placed at the same spatial density and soil mixture as trial 1, but will be raised in 1.0 x 1.5 m polyethylene pools framed with 1" x 1" Corners Limited aluminum tubing covered with polyester netting. Survival will be quantified and statistically compared with Mann-Whitney U testing (5).

**Experiment 2- gel diet feeding trial.** We will prepare a custom gel diet for *Lycaena* as described by Morton (6). In this experiment, we will raise a group of 50 *Lycaena* caterpillars at a density of 5 larvae / smartweed. Another 50 larvae will be raised on a gel diet prepared from dried smart weed. Body mass of each pupa will be recorded and compared between experimental treatments with t-testing (5). This is the only WBI butterfly that is multiple-brooded (7,8). Ellsworth and Tolson will perform these tasks daily at TTZ from May through Oct. in 2004 and 2005.

**Task 4. Develop breeding protocols for WBI butterflies.** We will use the successful techniques developed for butterflies under our previous IMLS grant as a starting point (4). To keep adult energy levels high, they will be hand fed using a 20% solution of raw honey (*Lycaena*, *Calephelis*) or maple syrup (*Neonympha* and *Satyrodes*). These hand-feeding techniques were shown to greatly extend adult longevity in adult oak savanna butterflies in our previous IMLS research (4). Maple syrup will be substituted for honey in *Neonympha* and *Satyrodes* as these species are reported to feed on tree sap (9-12). We will provide a slurry of mammal dung for all male butterflies to supply salts and other essential nutrients. In setting up breeding attempts, we will compare use often groups of five males placed with a single eclosing females in an outdoor flight cage with high light intensity and dense plantings of host plants with ten single pair matings in larval rearing chambers as described above. Fecundity/fertility of all females will be quantified and compared between groups w/ Mann-Whitney U testing (5). Ellsworth, Tolson, and Magdich will share this task, which will be carried out at TTZ from May-Oct. 2004 and May- Oct. 2005.

**Task 5. Develop over-wintering protocols for WBI butterfly larvae.** The critical data collected from Task 2- over-wintering site architecture, T, and RH- will be used in attempts to over-winter WBI larvae. In this task, the northern eyed brown, *Satyrodes euridice*, will also be used as a

surrogate for Mitchell's satyr until techniques are perfected. We will initially experiment with three techniques: over-wintering in outdoor enclosures on the host plants or in duff, overwintering in a layered substrate covered by an inverted clay pot as described by Friedrich (13), and over-wintering in a near-saturated atmosphere in an environmental chamber used in our previous KBB work. We will attempt to replicate conditions discovered in task 2 in miniature to over-winter target species in the open adjacent to our butterfly propagation facilities, then compare survival with butterflies over-wintered in our butterfly over-wintering jars in the environmental chamber. Groups of no less than ten larvae of each species will be used in experimental treatments, and a control group of no less than ten butterfly larvae of each species will be over-wintered at collection sites at the BSGA, Cedar Bog, and the Toledo Express Airport. Soil composition will be determined from task 1. For duff we will use an equal mixture of sand, sphagnum, and dried host plant leaves. A similar mixture had the highest over-winter survival rates for frosted elfin pupae in our previous research. We will use ANOVA to compare the experimental treatments. Ellsworth and Tolson will perform this task at TTZ from Oct. 2004-May 2005 and Oct. 2005 through May 2006.

Our schedule of completion is particularly appropriate for this research because it is based on the natural cycles of the wetland butterflies and their host plants in the wild. Activities commence in the early spring as germination of the host plants begin and continue into late spring as the first *Lycaena*, *Neonympha*, and *Satyrodes* larvae break diapause. In late spring the first adult *Lycaena* appear, and *Neonympha* and *Satyrodes* larvae move into their later instars. In mid-summer the first *Calephelis*, *Neonympha*, and *Satyrodes* adults appear and fly into late summer and early autumn. Data collection continues through winter for over-wintering eggs and larvae. Collection of over-wintering data in the field is necessary to establish baseline values for further experimentation; thus this task will be accomplished first. Experiments will be performed concurrently when possible, thus saving time and energy. The appearance of different stages in the life cycle, i.e. eggs, larvae, pupae, and adults, will dictate the timing of subsequent separate experiments. Butterflies are perfect experimental subjects due to their ease of manipulation and limited space requirements. Our butterfly production allows large sample sizes for statistical treatment of data, usually t-tests, Mann Whitney U tests, and ANOVA for multivariate tests.

The Zoo research facilities housing butterflies include a 35' x 60' polyhouse, enlarged and renovated in 2003 to include an 8' x 35' free flight mating area, and adjacent indoor conservation facilities on the Zoo grounds housing environmental chambers and refrigeration units. Facilities are protected by 8' perimeter chain link fencing and 24-hr. security. There is no public access to this site. Butterflies are protected from spiders and other predators by netting over each individual pot housing eggs, larvae, pupae, or adults. All pots are checked every two days for insect health, plant rotation, and removal of any potential predators. Over-wintering eggs are housed on a platform of netting in a Plexiglas tube protected in glass mason jars covered with chiffon fabric. Housekeeping functions of this area are the responsibility of the project staff and facilities are kept clean and orderly. A fully equipped maintenance facility with trained staff is adjacent to the polyhouse for maintenance support of butterfly operations.

## **2. WHAT ARE THE PROPOSED CONSERVATION METHODS AND WHY ARE THEY CONSERVATIONALLY SOUND?**

It is our philosophy that plans for conservation breeding projects must seek to understand the natural processes relating to survival, mate selection, fertility, and fecundity in the wild. With funding from the ODNR and IMLS, we collected four years of environmental data during the flight periods of the KBB at the ASGA that allowed us to be the **first institution to successfully breed the KBB, the frosted elfin, and (we believe) *Lycaena* in captivity.** We will use this strategy in implementing a conservation breeding program for wetland butterflies. We have had great success mass-rearing hundreds of butterflies for release or captive breeding, using pairs or groups of reproductive butterflies or larvae in individual pots containing living host plants, coupled with hand feeding each day. **The modifications for WBI butterflies were developed in consultation with the USFWS and MDNR Mitchell's Satyr Recovery Teams.** Our protocols of assessing fecundity and fertility by reproductive output of living animals, rather than their sacrifice and dissection, is particularly appropriate for endangered species such as the WBI butterflies. With an animal as critically endangered as *Neonympha*, we believe it is appropriate to use a model species to perfect rearing and over-wintering techniques. *Satyrodes*, our model, is

closely related, sympatric with *Neonympha*, uses the same host plant, and also over-winters as a larva.

### 3. WHAT IS THE OBJECT(S) HISTORIC STRUCTURE(S), OR SPECIMEN(S) THAT IS THE FOCUS OF THIS PROJECT?

The objects of this research are three endangered species of wetland butterflies, the Mitchell's satyr, *Neonympha mitchellii*, the purplish copper, *Lycaena helloides*, and the swamp metalmark, *Calephelis muticum*. These species are components of a unique and near-vanished wetland butterfly fauna of Northern Ohio. *Neonympha* was extirpated from the state in 1957, a victim of the relentless draining of fens, bogs, and other wetlands that soon followed the expansion into the Western Reserve at the turn of the 19th century. It is present in several disjunct localities in Michigan and Indiana in low numbers that make it particularly vulnerable to stochastic extinction processes. *Lycaena* and *Calephelis* barely hang on in Ohio- relicts of the Great Black Swamp that extended from the western Lake Erie marshes into the unique swales of the Oak Openings region of Northwest Ohio. Both are designated as Ohio S1 species- critically endangered in the state. Work in our region of Ohio has special relevance to the conservation of Ohio's biota by virtue of the fact it has more endangered species than any other locality in the state. The wetland butterflies were signature species of the Great Black Swamp, which once included Toledo. Butterflies have very high public appeal and have a special place within the psyches of most people who value our native biodiversity. Although a Far Side cartoon once humorously depicted a butterfly collector ironically describing a butterfly as a symbol of "innocence, beauty, and fragile life" as he placed it in a collecting jar, this statement has more than a ring of truth to it. In our experiences with butterfly outreach programs, our older audience consistently mentions the butterfly abundance and diversity they observed in their youth, lament its loss, and ask what can be done to bring it back. The USFWS, the AZA, and several conservation partners share this concern, and in 2001 launched the Butterfly Conservation Initiative (BFCI), a comprehensive program to recover the 22 species of endangered U.S. butterflies. TTZ was a founding member of that coalition, and this project is a component of that partnership effort and is endorsed by the BFCI, USFWS, the Ohio DNR, the Michigan Natural Features Inventory, and the AZA Terrestrial Invertebrate TAG. The conservation of the flora and fauna of Northwestern Ohio is particularly well suited to our mission, which is **"... to promote wildlife and its conservation through excellence in animal management, educational programs, and scientific activities..."** The regional flora and fauna are extremely popular with the residents of Lucas County. Because of our prior successes with oak savanna butterflies, local butterflies are now a **significant part of our institutional identity** with our public and our peers.

### 4. HOW DOES THE PROJECT RELATE TO YOUR MUSEUMS ONGOING CONSERVATION ACTIVITIES?

Our Conservation Master Plan emphasizes that **"New conservation programs will be developed to serve local conservation priorities for both plants and animals..."** We believe that we have a special responsibility for the conservation of animals and plants of our community. Now that the Zoo's KBB population is stable, the Wetland Butterfly Initiative has emerged as the TTZ's greatest conservation priority and is a natural progression in butterfly conservation activities as envisioned in the Zoo's Conservation Master Plan. In February 2003 Tolson was invited to become a member of the Michigan Mitchell's Satyr Working Group and the TTZ was officially sanctioned to develop captive breeding and rearing protocols for *Neonympha* using *Satyrodes* as a model. With permits from the Michigan DNR, Zoo conservation staff collected a female *Satyrodes* that laid 76 eggs in July 2003. These eggs subsequently hatched and at this writing are being held as 3rd and 4th instar larvae at the Zoo's butterfly facility.

*Lycaena* were first collected by Zoo conservation staff in June 2003 as part of an cooperative emergency rescue with the Ohio DNR when their Northwest Ohio habitat, consisting of only 38 m of a drainage ditch at Toledo Express Airport, was mowed to the ground by township road crews in the middle of the first flight, obliterating all adjacent nectar sources and mature host plants. Sixteen eggs were collected from the debris by Zoo conservation staff and 15 adults were successfully raised, ultimately resulting in more than 300 adults eclosing at our butterfly facility. From subsequent breedings of this group we will attempt to over-winter 100 larvae. Both *Neonympha* and *Satyrodes* present rearing difficulties. In initial rearing experiments with both species, newly hatched

caterpillars disappeared from rearing enclosures at two different facilities, due to unknown causes (14). Clearly, much has to be learned about larval movements and adequate confinement. The biology of over-wintering larvae is completely unknown, although they are hypothesized to enter diapause and over-winter in the 4th or 5th instar (7-10). This project builds on our award winning conservation program for the oak savanna butterflies of the Oak Openings Region of Northwest Ohio. IMLS CP grants IC-90032-99 and IC-03-02-0049-02 allowed us to answer several critical questions related to KBB fecundity and longevity. Implementation of this **IMLS- sponsored research allowed us to achieve record levels of adult longevity, egg production, hatching success of 2nd brood eggs, and eclosure success in 2001 and fertility and fecundity in 2002.** The program was so successful that it was used as a national model for butterfly conservation in a BFCI workshop given by the AZA and USFWS for potential butterfly conservation partners in 2002. Our wetland butterfly work follows a string of conservation successes for U.S. endangered species, including a comprehensive program of captive breeding, recovery, and reintroduction for the Virgin Islands boa. **IMS support played a pivotal role in the implementation of this program** (IMS CP grants IC-70095-87, IC-90453-89). IMS/ IMLS-sponsored research has led to publication of numerous research papers and a book by the Project Director. In fact, TTZ has won national recognition for its conservation programs with **four AZA Conservation Awards in the past seven years**, including the North American Conservation Award in 2003 for its Oak Savanna Butterfly Conservation Program.

#### **4. WHAT ARE THE ANTICIPATED BENEFITS OF THIS PROJECT?**

Acquisition of these data will **solve immediate, critical problems in the reproductive management of our butterfly collection.** In initial rearing experiments with the *Neonympha* and *Satyrodes* newly hatched caterpillars disappeared from rearing enclosures at two different facilities, including our own (13), due to unknown causes. Clearly, much has to be learned about larval movements and adequate confinement. The biology of over-wintering larvae is unknown, although they are hypothesized to enter diapause in the 4th or 5th instar. Behavior of *Lycaena*, *Neonympha*, and *Satyrodes* are very different from KBBs and elfins. They are much more mobile, more catholic in their host plant selection, and are clearly more difficult to over-winter as larvae than KBB eggs or elfin pupae. Any research dedicated to increasing over-winter survival of larvae will benefit other zoo programs that depend on the over-wintering of larvae for their conservation programs. Determination of optimal rearing and breeding conditions for adult WBI butterflies, larvae, and eggs will increase the demographic stability and increase the probability of the long-term survival of these three species in captivity. These data are critical. This information would benefit many other institutions that wish to initiate wetland butterfly conservation breeding programs through the AZA BFCI. **The techniques we developed for the KBB are being used as a model** for other endangered butterflies through the BFCI. In addition to developing protocols for assuring the long-term viability of the WBI collection, we will publish and update a comprehensive husbandry manual for WBI butterflies, similar to the one we developed and published for the KBB as a result of IMLS grant IC-90032-99. This manual will be available *gratis* to other institutions that wish to breed wetland butterflies in captivity. The results of our latest research will be published in peer-reviewed journals and presented at scientific meetings. In the future, results from this research can be used to augment the numerous precarious populations of the WBI butterflies in the wild, or to restore them to other states from which they have been extirpated. Our landscape management efforts for WBI butterflies, undertaken in partnership with The Nature Conservancy, include direct participation in restoration and replanting of habitat for WBI and other butterflies. These activities in turn indirectly benefit other wetland species of the Oak Openings, such as the state endangered spotted turtle and blue-spotted salamander.

#### **5. HOW WILL THE APPLICANT ENSURE THAT ONGOING MUSEUM FUNCTIONS ARE NOT INHIBITED BY THESE PROJECT ACTIVITIES?**

**Financial Resources:** The required institutional contribution will not negatively affect our other operations. Funding for conservation project support, including this project, is provided each year in the budget of the Conservation Department. These allocations have significantly increased each year for the past several years and are currently at record levels for our department, including a 26.5 % increase over FY 2002. Our direct mail appeal, the Animal Rescue and Conservation Fund, has resulted in additional revenue for conservation activities, allowing us to

increase our commitment to conservation projects in each of the past five years. A \$24,000 cash match provided by the ODNR will augment TZG and IMLS funding of the project.

**Human resources:** *In situ* conservation activities are embraced as a normal part of our staff responsibilities. Since 1992, both Tolson and Magdich have devoted summer conservation activities to butterflies almost exclusively. Magdich will aid in supervision of this project during any absences of the Project Director, so there will be minimal impact on other conservation projects. A technician hired specifically for the project will conduct experimental manipulations, monitoring, and provide care for the experimental groups throughout the year. We designed this research so that a number of experiments can be performed concurrently, thus saving technician time. A member of the research team will always be on grounds or available when travel away from the facility is needed. This arrangement served us well in our previous KBB research

## **7. HOW DOES THE PROJECT BUDGET SUPPORT THE GOALS AND OBJECTIVES?**

The budget was developed from our extensive experience of field and propagation research for Lycaenid butterflies from 1992- present and by consultation with the ODNR and Michigan and Federal Mitchell's Satyr Recovery Teams. The equipment we selected gives excellent value for the money without sacrifice of durability, precision, or reliability. Heater selection was based on energy efficiency and the capacity needed to heat the facility on a limited basis and was selected in consultation with our maintenance department. We canvassed several suppliers to obtain the most economical price for our supplies and materials and made an effort to purchase equipment directly from the manufacturer when possible. Our equipment was selected for quality, reliability, and cost-effectiveness- priced by direct quotes from suppliers, manufacturers, and off-the-shelf prices for common items. We attempted to be as frugal as possible without jeopardizing experimental design and quality. We are in the enviable position of being able to use husbandry and horticultural equipment from our previous IMLS sponsored research, thus keeping equipment expenditures to a minimum. Soil, however, must be replaced each year to reduce parasite and predator loads. The position of Research Technician is justified by our critical need for close monitoring of equipment and butterflies of all life stages during the course of this study. Our technician wages were developed in consultation with the ODNR, who will provide the cash match to fund this position. We have designated this position as hourly so we can schedule the technician according to research needs. We will use the services of two Research Fellows to aid the Research Technician in the summer when the workload will be the highest.

## **8. WHAT ARE THE QUALIFICATIONS OF THE PROJECT PERSONNEL?**

The project will utilize the skills of Peter J. Tolson, PhD., TTZ Director of Conservation, Mitchell L. Magdich, TTZ Curator of Education, two Research Fellows dedicated to the project, and Candee L. Ellsworth, a 1/2 time Research Technician hired specifically for the project. Design, experimental set-up, and project supervision will be the responsibility of Tolson, who will also aid in implementation of the project. Magdich will aid in supervision and implementation of this project, especially when Tolson is not present. Ellsworth will be responsible for maintenance and manipulation of experimental and control groups as well as care of host plants and equipment. Principals have experience with the environmental systems and data loggers from previous projects. The Fellows will aid Ellsworth in care of butterflies, larvae, pupae, and eggs and maintaining the research facilities. Tolson and Magdich have a long history of successful fieldwork with endangered species and were awarded the 1998 Conservation Colleague Awards by The Nature Conservancy for their work with the KBB. Both received USFWS Endangered Species Program awards in 2000 for their work with the KBB and other endangered U.S. Species. The group effort led to the TTZ receiving the AZA North American Conservation Award in 2003. Magdich has an intimate knowledge of the butterfly and plant communities of the Oak Openings and has long been associated with the ODNR as a result of his surveys for the KBB and the wild lupine. Tolson is best known for work with West Indian boas, for which he has won both the AZA Bean Award and the AZA Conservation Awards for the TTZ. He has worked with Magdich on recovery of oak savanna butterflies for the past 10 years. There are several university students with butterfly experience available for seasonal work related to WBI husbandry and experimentation as well as Ellsworth, who has been instrumental in the supervision of five research fellows and seasonal workers in the propagation and care of WBI butterflies and host plants.

### Schedule of Completion

May 04 Jun 04 Jul 04 Aug 04 Sep 04 Oct 04 Nov 04 Dec 04 Jan 05 Feb 05 Mar 05 Apr 05

## CONSERVATION COMPONENT

Develop horticultural techniques for wetland plants

Collect environmental data

Search for over-wintering larvae

Larval rearing/ gel feeding

### Breeding experiments

### Larval Overwintering

### EDUCATION COMPONENT.

### Filming and production

## DVD replication

Graphic design- DVD sleeve

## Lesson plan development

May 05 Jun 05 Jul 05 Aug 05 Sep 05 Oct 05 Nov 05 Dec 05 Jan 06 Feb 06 Mar 06 Apr 06

## CONSERVATION COMPONENT

Larval rearing/gel diet

### Breeding experiments

### Larval Over-wintering

## EDUCATION COMPONENT

## Lesson plan graphic design

Printing curriculum, poster

## Assemble teacher packets

Teacher training

## Project Budget Form Front

## SECTION 1: DETAILED BUDGET - CONSERVATION PROJECT SUPPORT

Name of Applicant The Toledo Zoo

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

## SALARIES AND WAGES (PERMANENT STAFF)

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<u>Peter J. Tolson</u>	<u>(1)</u>	<u>2 years @ \$55,000/ year</u>		<u>\$16,500</u>	<u>\$16,500</u>
<u>Director, Conservation</u>	<u>( )</u>	<u>x 15% time</u>			
<u>Mitchell D. Magdich</u>	<u>(1)</u>	<u>2 years @ \$48,000/ year</u>		<u>\$4,800</u>	<u>\$4,800</u>
<u>Curator, Education</u>	<u>( )</u>	<u>x 5% time</u>			
<b>TOTAL SALARIES AND WAGES</b>			<b>\$</b>	<b>\$21,300</b>	<b>\$21,300</b>

## SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<u>Candee L. Ellsworth</u>	<u>(1)</u>	<u>2200 hours @ \$13.00/ hour</u>	<u>\$28,600</u>	<u>\$28,600</u>	<u>\$57,200</u>
<u>Research Technician</u>	<u>( )</u>				
<u>Research Fellow</u>	<u>(2)</u>	<u>2 months/ year @ \$1,000/ mo.</u>		<u>\$4,000</u>	<u>\$4,000</u>
	<u>( )</u>	<u>x 2 years</u>			
<b>TOTAL SALARIES AND WAGES</b>			<b>\$ 28,600</b>	<b>\$32,600</b>	<b>\$61,200</b>

## FRINGE BENEFITS

RATE	SALARY BASE	IMLS	MATCH	TOTAL
<u>P. Tolson</u>	<u>30 % of \$16,500</u>		<u>\$4,950</u>	<u>\$4,950</u>
<u>M. Magdich</u>	<u>30 % of \$4,800</u>		<u>\$1,440</u>	<u>\$1,400</u>
<u>C. Ellsworth</u>	<u>30 % of \$28,600</u>	<u>\$8,580</u>		
<b>TOTAL FRINGE BENEFITS</b>		<b>\$ 8,580</b>	<b>\$6,390</b>	<b>\$14,970</b>

## CONSULTANT FEES

NAME/TITLE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR Hrs) ON PROJECT	IMLS	MATCH	TOTAL
<b>TOTAL CONSULTATION FEES</b>			<b>\$</b>		

## TRAVEL

FROM/TO	NUMBER OF: PERSONS DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	MATCH	TOTAL
<u>Toledo/ BSGA</u>	<u>(2) (12)</u>	<u>\$720</u>	<u>\$1,864</u>	<u>\$2,584</u>		<u>\$2,584</u>
<u>Toledo/ Urbana</u>	<u>(2) (12)</u>	<u>\$720</u>	<u>\$968</u>	<u>\$1,688</u>		<u>\$1,688</u>
<u>Toledo/ Swanton</u>	<u>(2) (12)</u>	<u>\$240</u>	<u>\$195</u>	<u>\$435</u>		<u>\$435</u>
	<u>( ) ( )</u>					
<b>TOTAL TRAVEL COSTS</b>				<b>\$ 4,707</b>		<b>\$4,707</b>

## Project Budget Form Back

**SECTION 1 - CONSERVATION PROJECT SUPPORT-CONTINUED****MATERIALS, SUPPLIES, AND EQUIPMENT**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Horticultural supplies	See breakdown	\$550		\$550
Butterfly rearing supplies	See breakdown	\$800		\$800
Soil testing equipment	See breakdown	\$841		\$841
Polyethylene pools	2 pools @110 ea.	\$220		\$220
<b>TOTAL COST OF MATERIAL, SUPPLIES, &amp; EQUIPMENTS</b>		<b>\$2,411</b>		<b>\$2,411</b>

**SERVICES**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Color copies, husbandry manual	20 pages@ \$.89/page x 25	\$445		\$445
1st class postage, husbandry manual	25 copies @ \$4.14	\$104		\$104
<b>TOTAL SERVICES</b>		<b>\$ \$549</b>		<b>\$549</b>

**OTHER**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Reznor 240,000 BTU heater	each	\$1,193		\$1,193
1" x 1" aluminum tubing	56' @ 2.00/ foot	\$112		\$112
<b>TOTAL COST OF OTHER</b>		<b>\$ \$1,305</b>		<b>\$1,305</b>

<b>TOTAL DIRECT PROJECT COSTS</b>	<b>\$ 46,152</b>	<b>\$60,290</b>	<b>\$106,442</b>
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**INDIRECT COSTS**

Check either A or B and complete C (see page 4.6 for an explanation of indirect costs).

- ☒ A. an indirect cost rate which does not exceed 20% of modified total direct costs – may be listed only as cost sharing and not to exceed \$10,000.
- ☐ B. Federally Negotiated Indirect Cost Rate (see page 4.6).

*Note: may be applied to both IMLS and match columns – total direct costs charged to IMLS even with a pre-negotiated indirect cost rate must not exceed \$50,000 or \$75,000 (if an exceptional project).*

\_\_\_\_\_  
Name of Federal Agency

\_\_\_\_\_  
Effective Date of Agreement

C. Rate	base(s)	Amount(s)	Amount(s)
20	% of \$	106,442	\$ 21,288
	% of \$		\$

<b>TOTAL INDIRECT COSTS</b>	<b>\$ 21,288</b>
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*Note: This page is part of the budget forms and must be included, whether or not you can claim an indirect cost rate.*

## Project Budget Form

**SECTION 3: SUMMARY BUDGET - CPS AND EDUCATION COMPONENT**Name of Applicant The Toledo Zoo

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

DIRECT COSTS	IMLS	MATCH	TOTAL
SALARIES AND WAGES (PERMANENT STAFF)		\$27,300	\$27,300
SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)	\$33,184	\$32,600	\$65,784
FRINGE BENEFITS	\$8,580	\$8,190	\$16,770
CONSULTANT FEES			
TRAVEL: DOMESTIC	\$5,830		\$5,830
FOREIGN			
SUPPLIES & MATERIALS	\$2,411		\$2,411
SERVICES	\$4,449	\$9,374	\$13,823
OTHER	\$1,305		\$1,305
<b>TOTAL DIRECT COSTS</b>	<b>\$ 55,759</b>	<b>\$ 77,464</b>	<b>\$ 133,223</b>
<b>INDIRECT COSTS*</b>	<b>\$</b>	<b>\$ 21,288</b>	<b>\$ 21,288</b>
			<b>TOTAL PROJECT COSTS \$ 154,511</b>
<b>AMOUNT OF CASH - MATCH</b>		<b>\$ 38,054</b>	
<b>AMOUNT OF IN-KIND CONTRIBUTIONS - MATCH</b>		<b>\$ 60,710</b>	
<b>TOTAL AMOUNT OF MATCH (CASH AND IN-KIND CONTRIBUTIONS)</b>		<b>\$ 98,754</b>	
<b>AMOUNT REQUESTED FROM IMLS</b>		<b>\$ 55,759</b>	
<b>PERCENTAGE OF TOTAL PROJECT COSTS REQUESTED FROM IMLS (MAY NOT EXCEED 50%)</b>		<b>36.1 %</b>	

Have you received or requested funds for any of these project activities from another federal agency? (please check one) ☐ Yes ☒ No

If yes, name of agency \_\_\_\_\_

Date \_\_\_\_\_

Amount requested \$ \_\_\_\_\_

## **Historic St. Mary's City (Sample Education Component)**

St. Mary's City, Maryland

Project Type: Detailed Survey

IMLS Award: \$59,904 (includes \$9,924 for education component)

Match: \$61,208

Total Project: \$121,112

Museum Budget: \$2,526,672

\$49,980 to conduct a detailed condition survey of selected archaeological collections recovered from the National Historic Landmark site of St. Mary's City, Maryland.

\$9,924 to create a full color illustrated brochure summarizing how conservation benefits the field of archaeology and is integrated into the archaeological process of a large and diverse historical artifact collection.

## EDUCATIONAL COMPONENT NARRATIVE

### 1: WHAT IS THE DESIGN OF THE EDUCATIONAL COMPONENT?

The educational component proposed for the project is designed to inform a variety of audiences in a range of disciplines about the significance of the appropriate approach to the conservation of historical archaeological artifacts. The educational outreach will take the form of a variety of specific products targeted to each of these various groups. The principle product will be a full color illustrated brochure summarizing how conservation benefits the field of archaeology and is integrated into the archaeological process of a large and diverse historical artifact collection. Using the detailed conservation survey of the Historic St. Mary's City Collections (IMLS Funded) as an example, the current best practice for conservation planning, survey techniques, and evolving treatment regimens will be described. While HSMC will be used for examples, the general goal will be to explain the underlying model for systematic conservation and the need for archaeologists to incorporate conservation planning before excavations begin. The document will include important resources on professional conservation groups so that organizations needing professional advice or services can be directed to the proper professionals. This brochure will be designed to reach both a general audience of interested individuals, and to help alert specialists in other areas, primarily historical archaeologists and museum specialists, to the very special conservation needs of historic, archaeological objects. In addition to printed copies of this brochure, a carefully designed web version of the document will be created and posted on the HSMC web site in order to reach the widest possible audience.

We intend to distribute this brochure at a variety of professional archaeological conferences to help educate archaeologists about the complexity of the process and the need to involve professional conservators in all phases of planning for excavations and eventual curation. These conferences include the Council for Northeastern Historical Archaeology (CNEHA) Annual meeting, the Middle Atlantic Archaeological Conference (MAAC), and the Annual Meeting of the Society for Historical Archaeology (SHA). The brochure will also be distributed at annual meeting of the American Institute for Conservation of Historic and Artistic Works (AIC) to reach conservators and conservation students in a variety of disciplines, and teach them of the special characteristics of historical archaeological collection so they can better appreciate the magnitude of such conservation. In addition, a local presentation with a popular voice will be given at Historic St. Mary's City for the interested local community and the student body of the nearby St. Mary's College of Maryland. This local presentation will be sponsored by the Historic St. Mary's City Foundation and will include a small reception and will provide an opportunity to distribute copies of the brochure to the Museum's core constituency.

In order to assure that the educational goals of this component are met, the conservation and curation specialists will work directly with the Historic St. Mary's City Public Programs staff during the course of the detailed conservation survey. These individuals have considerable experience in education as they currently teach 28,000 Maryland students about archaeology and Maryland history every year. From the beginning of the overall conservation project, curation and conservation staff will meet with the Public Programs staff to outline educational goals and objectives. By carefully documenting the conservation survey process and distilling it into easily understandable components, we will seek to create products which increase sensitivity to and acceptance of the responsibility of stewardship for the past. To this end, regular meetings will be scheduled over the course of the project.

In addition to these regular meetings, the Consultant Conservator and Conservation Assistant will each dedicate 67 hours to prepare the text, select the illustrations and review educational goals and outcomes with the educational staff of the Museum. Also dedicating an equal amount of time to this phase of the project will be the Project Director who serves as curator for the Museum. Additionally, all these individuals will work with the Museum's Director of Communication and Marketing in the actual design and layout of both the brochure and web version. After a draft product is produced it will be reviewed by members of the educational staff and the Director of Research and the Museum's Executive Director, the Museum's Director of Communication and Marketing will solicit bids for printing the brochure. The finished brochure will be made available to all visitors to Historic St. Mary's City and distributed at professional archaeology, conservation, and museum conferences. Announcements of the availability of the electronic version of the brochure will be sent to a variety of museums, archaeology, conservation, and other humanities electronic discussion lists. We plan to create the final brochure after completion of the detailed conservation survey so that we will have access to the greatest number of examples and illustrations.

## 2: WHAT ARE THE ANTICIPATED BENEFITS OF THIS EDUCATIONAL PROJECT?

The primary anticipated benefit from the educational component of this project is an expanded appreciation for the responsibility that archaeologists and museum professionals have as stewards of archaeologically derived artifacts. Many people perceive archaeology as digging and fail to appreciate the work that must be done to understand and preserve the fragments of the past that are recovered in archaeological work. This project will educate a range of audiences that conservation is needed to make sure these items continue to exist so that future scholars can ask new questions. Archaeological resources are non-renewable - they are no longer making colonial capitals of Maryland. All excavations destroy the very archaeological record they seek to document. Careful preservation of all these materials is needed since future scholars will need to study past collections because only so many archaeological sites exist.

As part of the museum's educational mission, the staff of Historic St. Mary's City annually teaches two specific classes in Historical Archaeology at St. Mary's College of Maryland. These staff members serve as adjunct faculty at the college and for thirty years have taught an archaeological field school. For the past fifteen years, the staff has also taught a class in archaeological analysis and curation. For the past three years, both of these classes have included a lecture by a professional conservator to sensitize the students to the conservation responsibilities of historical archaeologists. The brochure will serve as part of the class materials given to archaeology students, and used to help increase their awareness of this important area of professional responsibility.

By reaching a wide range of audiences with the message of the significance of collection stewardship and conservation, museum specialists, professional archaeologists and the general public can be sensitized as to why scarce resources need to be dedicated not only to the preservation of archaeological materials, but also to collections surveys that allow conservation activities to be planned and executed with the most efficient possible use of time and resources. Conservation is perceived by some in the museum and archaeological community as a way of making artifacts more attractive for display purposes. Educating them that conservation is about gaining new information and preserving these scientific samples for future study is one of the greatest hoped for results of this project. By reaching the general public with these messages, support for greater government investment in this area can be fostered. It is hoped that the wide distribution of this brochure may inspire some students to focus on this area of need and pursue careers in archaeological conservation. By creating an electronic version of this brochure, we will be able to reach a much wider sample of individuals. Even after all the hard copy versions of the brochure have been distributed, this electronic version will continue to be available via the World Wide Web. The Consultant Conservator serves as the inter-society liaison between the Society for Historical Archaeology and the American Institute for Conservation. We intend to approach both AIC and SHA to seek their endorsement of this brochure and possible support for reprinting after the original production has been distributed.

## 3: HOW DOES THE PROJECT BUDGET SUPPORT THE EDUCATIONAL COMPONENT GOALS AND OBJECTIVES.

The budget was designed to provide time for the Conservation Consultant and Conservation Assistant, with the assistance of the above indicated museum staff, to prepare the text and select the illustrations for the conservation brochure. All requested moneys will be dedicated to fund the Conservation Consultant and Conservation Assistant and to pay the cost of printing the brochure. We have budgeted 67 hours by the Consultant Conservator and the Conservation Assistant to produce this text with the assistance of various museum staff. We want to dedicate half of the moneys we are requesting to print 10,000 copies of the brochure as a full color product with an eye pleasing design developed by the project staff working with the Director of Communications and Marketing. The electronic version will be posted on our web site at basically no cost other than the time of the Museum staff.

All project match will be derived from dedicated staff time by a variety of specialists currently working for the museum. The Director of Public Programs, the museum's Education Coordinator, the Curator of Collections, the Director of Research, the Director of Communications and Marketing and the museum's Executive Director will dedicate time to assist in the preparation and review of this brochure. The education staff, in particular, will work closely with the Consultant Conservator and Conservation Assistant, to be sure that the desired learner outcomes will be achieved by this brochure and that comprehensibility will be kept at level where most readers be able to "take away" the message of the need for collections stewardship.

#### 4: WHAT ARE THE QUALIFICATIONS AND RESPONSIBILITIES OF THE PROJECT PERSONNEL?

Details concerning all personnel who are involved in the overall survey project have been described under the general project narrative. Special aspects of their experience and training as it relates to the educational aspects of the project are provided below. Copies of resumes are provided in a separate appendix.

**Lisa Young (Consultant Conservator)** has 13 years of conservation and collections management experience. She has a B. Sc. in Archaeological Conservation (First Class Degree) from the University of Wales, Cardiff, U.K., and a B.A. in Anthropology from Mary Washington College, Virginia. She is an active member and participant of professional organizations including the Society for Historical Archaeology, the Council for Maryland Archeology, the American Institute for Conservation, and the Washington Conservation Guild. Ms. Young is a course instructor for the National Preservation Institute in which she teaches two courses-Archaeological Curation, Conservation and Collections Management and Field Conservation for Archaeologists. She has recently completed a USAID supported project in Alexandria, Egypt to train Egyptian conservators in the conservation of waterlogged organic materials. Ms. Young will serve as principal author of the brochure text.

**Silas D. Hurry (project Supervisor)** is the Museum's Curator of Collections. Mr. Hurry attended graduate school at Cambridge University in the United Kingdom. Mr. Hurry serves as adjunct faculty at St. Mary's College of Maryland. As Curator of Collections Mr. Hurry has been involved in developing both exhibits and printed educational matter to accompany these exhibits. Mr. Hurry will assist with logistics and preparation of the brochure text.

**Henry M. Miller, Ph.D. (Research Director)** holds a Ph.D. in Anthropology from Michigan State University and now serves as Chairman for the Archaeological Ethics and Standards Committee of the Society for Historical Archaeology. In 1997 he served as the President of the Society for Historical Archaeology. Dr. Miller is widely published in professional journals and has contributed articles to several edited volumes. He is also an Adjunct Professor at St. Mary's College of Maryland. Dr. Miller will assist in reviewing the brochure content.

**Martin Sullivan, Ph.D. (Museum Director)** became the Executive Director of Historic St. Mary's City in the June of 1999. Dr. Sullivan (Ph.D. U.S. Social and Cultural History, University of Notre Dame) has over 30 years of demonstrated achievement in cultural management, including twenty years as a museum director. Dr. Sullivan will assist in reviewing the brochure content.

**Sara Rivers (Conservation Assistant)** has eight years of experience in archaeological excavation and collections management. She has a Masters of Applied Anthropology from the University of Maryland, College Park and a B.A. in History and Anthropology from Murray State University in Murray, Kentucky. Ms. Rivers has taken seminars in conservation at the Smithsonian's National Museum of Natural History with Dr. Carolyn Rose, Natalie Firnhaber, and Greta Hansen. Recently she has participated as panelist discussing conservation surveys and collection stewardship at the annual meeting of the Middle Atlantic Association of Museums. Ms. Rivers will assist in preparing the brochure text.

**Dorsey Bodeman (Director of Public Programs)** has over 20 years of experience in education, including 7 years as a classroom teacher. Since 1986 Ms. Bodeman has worked in the education arena in museum settings at a variety of sites including the Jefferson homes of Monticello and Poplar Forest, Jamestown, and St. Mary's City. Ms. Bodeman has participated in numerous professional meetings and taught Teacher Institutes in colonial history at Historic St. Mary's City. Ms. Bodeman will review the brochure to assure that we meet the educational goals.

**Jennifer Yaremczak (Education Coordinator)** has a BA in History from Gettysburg College and an MA in History from the University of Delaware with a Certificate in Museum Studies. She completed internships at Winterthur's Historic Houses of Odessa in Delaware, The National Museum of American History in Washington, D.C., and The Gilder Lehrman Collection in New York City. Ms. Yaremczak will assist in reviewing the brochure to assure that we meet the educational goals.

**Susan G. Wilkinson (Director of Communications and Marketing)** has a B.A. from St. Mary's College of Maryland and has served as Director of Communications and Marketing for Historic St. Mary's City since July 2000. In this capacity she directs institutional communications, marketing, and media relations for the museum. Duties also include the design, production, and management of advertising, marketing material, and the museum web site. Ms. Wilkinson will design the layout of both the brochure and the web version of the presentation.

## Project Budget Form Front

## SECTION 2: DETAILED BUDGET - EDUCATION COMPONENT

Name of Applicant Historic St. Mary's City (If Applicable)

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

## SALARIES AND WAGES (PERMANENT STAFF)

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Silas Hurry, Curator	(1)	50x \$25.17		\$1258.50 ✓	\$1258.50
D. Bodeman, Dir P.P.	(1)	50 x \$24.22		\$1211.00 ✓	\$1211.00
Henry Miller, Res. Dir	(1)	25 x \$29.22		\$730.50 ✓	\$730.50
M Sullivan, Exec. Dir	(1)	25x \$65.00		\$1625.00 ✓	\$1625.00
<b>TOTAL SALARIES AND WAGES</b>			<b>\$</b>	(cont)	(cont)

## SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Sara Rivers, Con. Ast.	(1)	67 x \$13.50	\$904.50		\$904.50
	( )				
	( )				
	( )				
<b>TOTAL SALARIES AND WAGES</b>			<b>\$</b>		\$904.50

## FRINGE BENEFITS

RATE	SALARY BASE	IMLS	MATCH	TOTAL
30 %	% of \$ 7137.80		\$2141.34 ✓	\$2141.34
	% of \$			
	% of \$			
<b>TOTAL FRINGE BENEFITS</b>		<b>\$</b>		\$2141.34 ✓

## CONSULTANT FEES

NAME/TYPE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR Hrs) ON PROJECT	IMLS	MATCH	TOTAL
Lisa Young, Con. Conserv.	\$60/hr	67	\$4020.00 ✓		\$4020.00
<b>TOTAL CONSULTATION FEES</b>			<b>\$ \$4020.00 ✓</b>		\$4020.00

## TRAVEL

FROM/TO	NUMBER OF: PERSONS DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	MATCH	TOTAL
	( ) ( )					
	( ) ( )					
	( ) ( )					
	( ) ( )					
<b>TOTAL TRAVEL COSTS</b>				<b>\$</b>		

## Project Budget Form Front

**SECTION 2: DETAILED BUDGET - EDUCATION COMPONENT**Name of Applicant Historic St. Mary's City (cont) (If Applicable)

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

**SALARIES AND WAGES (PERMANENT STAFF)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
S. Wilkinson, D. M.	( 1 )	60 hrs x \$25.73		\$1543.80 ✓	\$1543.80
J. Yaremczak, Ed. Cor	( 1 )	50 hrs x \$15.38		\$769.00 ✓	\$769.00
	( )				
	( )				
<b>TOTAL SALARIES AND WAGES</b>			<b>\$</b>	<b>\$7137.80 ✓</b>	<b>\$7137.80</b>

**SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
	( )				
	( )				
	( )				
	( )				
<b>TOTAL SALARIES AND WAGES</b>			<b>\$</b>		

**FRINGE BENEFITS**

RATE	SALARY BASE	IMLS	MATCH	TOTAL
	% of \$			
	% of \$			
	% of \$			
<b>TOTAL FRINGE BENEFITS</b>		<b>\$</b>		

**CONSULTANT FEES**

NAME/TYPE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR Hrs) ON PROJECT	IMLS	MATCH	TOTAL
<b>TOTAL CONSULTATION FEES</b>			<b>\$</b>		

**TRAVEL**

FROM/TO	NUMBER OF: PERSONS DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	MATCH	TOTAL
	( ) ( )					
	( ) ( )					
	( ) ( )					
	( ) ( )					
<b>TOTAL TRAVEL COSTS</b>				<b>\$</b>		

# Project Budget Form Back

## SECTION 2 - EDUCATION COMPONENT-CONTINUED

**MATERIALS, SUPPLIES, AND EQUIPMENT**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<b>TOTAL COST OF MATERIAL, SUPPLIES, &amp; EQUIPMENTS</b>				

**SERVICES**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
brochure printing	actual	\$5000.00		\$5000.00
<b>TOTAL SERVICES</b>		\$ 5000.00 ✓		\$5000.00

**OTHER**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<b>TOTAL COST OF OTHER</b>		\$		

<b>TOTAL DIRECT PROJECT COSTS</b>	\$ 9924.50 ✓	\$9279.14 ✓	\$19203.64
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## **Toledo Zoo (Sample Education Component)**

Toledo, Ohio

Project Type: Research

IMLS Award: \$55,759 (includes \$9,607 for education component)

Match: \$98,754

Total Project: \$154,513

Museum Budget: \$22,383,141

\$46,152 to study the development of conservation husbandry and breeding strategies that can be used for three endangered butterfly species: Mitchell's satyr (*Neonympha mitchelli*), purplish copper (*Lycaena helloides*) and swamp metalmark, (*Calephelis muticum*). \$9,607 to create a curriculum on the conservation of these species and work with state organizations to create a DVD for the public.

## 1. WHAT IS THE DESIGN OF THE EDUCATION COMPONENT?

The staff of the Education Department of The Toledo Zoo (ITZ) plans to develop a curriculum that concentrates on the conservation of two Ohio state listed endangered butterflies, the swamp metalmark, *Calephelis muticum*, and the purplish copper, *Lycaena belloides*. The development of these materials would complement and coincide with conservation and recovery efforts planned for these two species by the Zoo's Conservation and Research Department. The goal of the project is to raise the awareness of teachers and students regarding two state endangered species of wetland butterflies and the causes for their decline.

The theme for the curriculum is "Beautiful Butterflies are Vanishing from Ohio's Wetlands!" The sub-themes are "I'm Starving!", "I'm Homeless!", and "Does Anyone Care?" The theme and sub-themes attempt to create a blend of tangible and intangible messages, providing a balanced presentation that makes the information relevant and provocative to elementary school children. Two of the sub-themes address factors key to the survival of the butterflies. "I'm Starving!" addresses the nutritional needs of the larvae and adult butterflies. "I'm Homeless!" addresses habitat loss and fragmentation. The remaining sub-theme "Does Anyone Care?" is a call to action to preserve the butterflies and their habitat.

TTZ Education staff will work with the Zoo's Conservation and Research Department and the Ohio Department of Natural Resources to produce two ten minute video segments about both butterfly species. The videos will focus on the main theme and sub-themes. The content and production will be age appropriate for the elementary level. After production, the videos will be converted to a DVD format for distribution. Two hundred fifty DVDs will be produced.

A curriculum component will be created to complement the DVD videos. The curriculum will be divided into three units for each of the two video segments. Each unit will focus on each of the sub-themes. Two hundred fifty copies of each of the 24 lessons will be produced. Additionally, curricula will be divided into two modules; one focused on grades 1-3 and the other grades 4-6 (see table 1).

Table 1

		Sub-Themes (Units)		
		I'm Starving!	I'm Homeless!	Does Anyone Care?
Purplish	Grades 1-3 module	2 lessons	2 lessons	2 lessons
Copper	Grades 4-6 module	2 lessons	2 lessons	2 lessons
Swamp	Grades 1-3 module	2 lessons	2 lessons	2 lessons
Metalmark	Grades 4-6 module	2 lessons	2 lessons	2 lessons

The curriculum will be developed using the 5-E instructional model, a widely recognized, inquiry-based, constructivist learning model. All lessons will be aligned to the Ohio State Proficiency Outcomes for Science.

The final piece for the education component will be a color poster depicting each butterfly. Text will be included, addressing each of the aforementioned sub-themes. One thousand posters will be produced. When the DVDs, curriculum, and posters are ready for distribution, TTZ Education Department staff will conduct teacher workshops to train elementary teachers to use the materials. Emphasis will be placed on disseminating curriculum to teachers in schools that are within a 15-mile radius of the butterflies' habitats.

Mitchell Magdich, TTZ Curator of Education, will supervise the education component. Approximately 5% of his time will be allocated for this project. A temporary employee hired specifically for the project will be Science Education Specialist Karen Mitchell, a retired schoolteacher who has extensive experience in elementary science education methodologies. Mitchell will develop the curriculum. Linda Calcamuggio, Education Specialist at TTZ, will coordinate teacher training. Videography and production of the video component and poster design will be done by employees of the Ohio Department of Natural Resources (ODNR). The Toledo Zoo Interpretive Services Department will prepare curriculum materials for print production, and design the DVD label and sleeve jacket. Vanessa Neeb, Curator of Interpretive Services at TTZ, will supervise graphics design of the educational curriculum, and design of the DVD label and sleeve jacket.

Preparation of the educational materials will begin in the spring of 2004 with teacher workshops beginning in fall of 2005. This schedule is appropriate because production, such as videography will be operating concurrently with the conservation project field season and the butterfly flights; the products will be completed for the following school year.

## **2. WHAT ARE THE ANTICIPATED BENEFITS OF THIS EDUCATIONAL PROJECT?**

There is a general lack of knowledge of endangered animals endemic to one's immediate area, especially if those animals are not well represented in the media. Most children's books and school textbooks concentrate on more prolific endangered animals that occur in distant areas of the world. Little attention is given to local endangered species of animals and the root causes of their demise. The project will serve to make a local connection to this global dilemma, making the topic much more relevant and timely to teachers and students alike. In addition, the root issues of endangerment such as habitat loss, habitat fragmentation, habitat alteration and inappropriate pesticide application can be investigated from a relevant and concrete framework since teachers and students are able to observe the phenomenon first hand. Ultimately, the project will raise the awareness of teachers and students regarding two state endangered species of wetland butterflies and the causes for their decline. This will be accomplished by 1) implementing a well-designed curriculum and 2) by training teachers to use it. Consequently, teachers and students will know about the butterflies' natural history, their habitat, the various plants that the butterflies require for survival and the reasons for the butterflies' demise. As an informed audience, teachers and students will be more capable of identifying opportunities to protect the butterflies and their habitat and take appropriate action. Once teacher awareness has been aroused and production has been completed, subsequent classes of students can be educated about conserving these butterflies long after the project period has ended.

## **3. HOW DOES THE PROJECT BUDGET SUPPORT THE EDUCATION COMPONENT GOALS AND OBJECTIVES?**

Costs for producing and replicating the DVDs and for printing the curriculum and the poster are based on estimates from reliable vendors who have a track record of quality work for TTZ. The labor costs for writing the curriculum are based on a written proposal from Mitchell. The labor costs for a graphic designer for the curriculum and poster are based on an estimate provided by the Curator of Interpretive Services at The Toledo Zoo based on current rates for the pool of part time graphics support staff currently employed by TTZ. The Zoo's in kind match is based on current salaries, wages, and fringe benefits for Zoo staff in the Education Department and Interpretive Services Department, while the Ohio Department of Natural Resources in kind match is based on their experience with current industry standard costs for filming and producing two-ten minute video programs. Mileage costs are based on the federal rate and ten projected day trips to both Urbana and Whitehouse area schools for the teacher training. We attempted to be as frugal as possible without jeopardizing educational objectives and quality.

#### **4. WHAT ARE THE QUALIFICATIONS AND RESPONSIBILITIES OF THE PROJECT PERSONNEL?**

Curator of Education, Mitchell L. Magdich, supervises all of the Zoo's educational functions including public programs, interpretive programs, school programs, home school programs, outreach programs, overnight programs, camps, distance learning, the Children's Zoo, the library, the science resource center, teacher training and docent training. He has over 14 years experience in Zoo education and over 18 years as an informal science educator including employment as a park naturalist. Mr. Magdich has a Bachelor of Education degree from the University of Toledo. Magdich will supervise the education component of the project.

Magdich has been conducting research on Ohio's threatened and endangered butterflies for 16 years. He conceived and developed the Ohio reintroduction of the federally endangered Karner blue butterfly (*Lycaeides melissa samuelis*) to Ohio, a project implemented by the Conservation and Research Department of TTZ. Magdich is also a member of the steering committee and is the chairperson of the education subcommittee for the Butterfly Conservation Initiative (BFCI), a national butterfly recovery program administered through the American Zoo and Aquarium Association (AZA). He has received several awards related to his work with butterflies including the 1998 Conservation Colleague Award from The Nature Conservancy, The United States Fish and Wildlife Service National Endangered Species Program Award in 2000, the AZA Outstanding Service Award in 2002, and was a key member of the group that obtained the AZA North American Conservation Award for TTZ in 2003. He also produced the educational loan boxes that were cited as a key feature of the lake sturgeon educational effort that resulted in the Mace Award in 1997.

Vaneesa Neeb, Curator of Interpretive Services at TTZ, will supervise graphic design of the educational curriculum, design of the DVD label and sleeve jacket and design of the wetland butterfly poster at TTZ. Neeb has several award-winning design efforts to her credit, including the graphic designs for TTZ Aviary, which won the AZA Exhibit Award in 1999 and the Aquarium graphics for lake sturgeon that won the Mace Award in 1997. Artists and designers hired through the Interpretive Services Department at The Toledo Zoo will do graphic design of the curriculum. Department staff have extensive experience in design and production of posters, brochures, pamphlets, booklets, reports, educational materials, murals, signs and exhibits that are used or displayed throughout The Toledo Zoo.

Linda Calcamuggio, Education Specialist, has 4 years experience as a Zoo educator. She has direct oversight of the Zoo's distance learning, overnight, and teacher in-service programs. Calcamuggio will conduct and supervise the teacher-training segment of the education component.

Karen Mitchell is a retired elementary school teacher with over 30 years experience in the classroom. Mitchell has extensive experience in science education methodologies and has participated and assisted in TTZ education programs for more than 10 years. Mitchell will oversee the development of the butterfly curriculum.

The Ohio Department of Natural Resources (ODNR) will provide staff for the filming and production of the video segments. ODNR has extensive experience in videography, having filled and produced the widely distributed 30-minute program Wild Ohio! for several years. ODNR will also design the poster.

## Project Budget Form Front

**SECTION 2: DETAILED BUDGET - EDUCATION COMPONENT**Name of Applicant The Toledo Zoo (If Applicable)

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

**SALARIES AND WAGES (PERMANENT STAFF)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
M. Magdich/ Curator, E	(1)	5% of yearly base salary		\$2,400	\$2,400
V. Neeb/ Curator,	(1)	5% of yearly base salary		\$2,400	\$2,400
Interpretive Services	( )				
Linda Calcamuggio	(1)	4% of yearly base salary		\$1,200	\$1,200
<b>TOTAL SALARIES AND WAGES</b>			<b>\$</b>	<b>\$6,000</b>	<b>\$6,000</b>

**SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)**

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Karen L. Mitchell	(1)	\$22/ hour x 72 hours	\$1,584		\$1,584
Sci. Education Spec.	( )				
TTZ Support staff	(1)	\$25/ hour x 120 hours	\$3,000		\$3,000
Graphic artist	( )				
<b>TOTAL SALARIES AND WAGES</b>			<b>\$ \$4,584</b>		<b>\$4,584</b>

**FRINGE BENEFITS**

RATE	SALARY BASE	IMLS	MATCH	TOTAL
M. Magdich 30 % of \$	\$2,400		\$720	\$720
V. Neeb 30 % of \$	\$2,400		\$720	\$720
L. Calcamuggio 30 % of \$	\$1,200		\$360	\$360
<b>TOTAL FRINGE BENEFITS</b>		<b>\$</b>	<b>\$1,800</b>	<b>\$1,800</b>

**CONSULTANT FEES**

NAME/TYPE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR Hrs) ON PROJECT	IMLS	MATCH	TOTAL
<b>TOTAL CONSULTATION FEES</b>			<b>\$</b>		

**TRAVEL**

FROM/TO	NUMBER OF: PERSONS DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	MATCH	TOTAL
Toledo/ Urbana	(1) (10)		\$806	\$806		\$806
Toledo/ Swanton	(1) (20)			\$317		\$317
	( ) ( )					
	( ) ( )					
<b>TOTAL TRAVEL COSTS</b>				<b>\$ 1,123</b>		<b>\$1,123</b>

## Project Budget Form Back

## SECTION 2 - EDUCATION COMPONENT-CONTINUED

## MATERIALS, SUPPLIES, AND EQUIPMENT

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<b>TOTAL COST OF MATERIAL, SUPPLIES, &amp; EQUIPMENTS</b>				

## SERVICES

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
VHS/ DVD replication	250 copies@ \$3.60	\$900		\$900
Print poster, curriculum	1000 copies@ \$1/ 250 @ \$1.24	\$3,000	\$5,454	\$8,454
Poster design	\$53/ hour x 40 hours		\$1,800	\$1,800
Filming/ production	\$53/ hour x 40 hours		\$2,120	\$2,120
<b>TOTAL SERVICES</b>		<b>\$ 3,900</b>	<b>\$9,374</b>	<b>\$13,274</b>

## OTHER

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<b>TOTAL COST OF OTHER</b>		<b>\$</b>		

<b>TOTAL DIRECT PROJECT COSTS</b>	<b>\$ 9,607</b>	<b>\$17,174</b>	<b>\$26,781</b>
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**Arizona State University Art Museum (Sample Education Component)**

Tempe, Arizona

Project Type: Training

IMLS Award: \$22,423 (includes \$8,236 for education component)

Match: \$25,737

Total Project: \$46,160

Museum Budget: \$709,322

\$14,187 to conduct collection care planning and staff training leading to the development of a Disaster Preparedness and Recovery Plan. \$8,236 to present a workshop entitled, "Collection Protection, Are You Prepared?" for campus museum, archive and library personnel.

## **EDUCATION COMPONENT- NARRATIVE**

"Integration of Cultural Properties with Existing Campus-wide Disaster Preparedness and Recovery Plan at ASU Art Museum, Tempe, AZ"

### **1. What is the design of the education component?**

The second component of the grant will be an educational outreach project designed to extend the information and experience gained from the conservation project and resulting Arizona State University Art Museum (ASUAM) Emergency Preparedness Plan to the university community. The objective is to broaden influence and form a network of collection managers, archivists and librarians on the ASU Main Campus and ASU West Campus. The project goals are to directly involved personal in planning and education sessions for emergency preparedness, efficiently stream line university emergency procedures common to all departments, share the advise of a conservation consultant, and plan for future collaborations to respond to emergencies and to write and update preparedness plans.

Campus efforts will be consolidated and updated by developing a new Emergency Response website for the university. This will allow campus museums, gallery personnel, collections managers, archivists, librarians, access to the 2006 ASUAM Emergency Plan, links to cultural property personnel, responders and references to ASU, State of Arizona, regional and national assistance. ASUAM staff and Project Conservator will co-host the 5-day campus-wide Emergency Preparedness and Recovery Workshop. During this workshop the participants from the previous year's training will exchange information with other departments, campus emergency responders will present updated information concerning procedures and a conservator will be available for site visit consultations.

The ASUAM Registrar, key staff and museum studies students estimate approximately 600 hours of service will be directed toward completion of this project. The schedule of events extends over an 18-month period, which allows adequate time for evaluation, revision and incorporation into the daily work schedule.

### **2. What are the anticipated benefits of this education project?**

The targeted audience for this education project will not necessarily be the general public that walks through the front door. Without doubt the emergency plan will protect the very collections the general audience travels to view but the primary focus will be the audience generally categorize as the repeat attendee. These students, volunteers and their friends; docents and their acquaintances; university faculty, staff and contacts, Board members and their associates and city residents involved with their neighboring university. These connections compound to significant numbers on a main campus with

48,901 students, 4,741 staff and faculty, and immediate university city and community of 158,625 population.

In addition to the confirmed campus participants listed in the Appendix, Phase II list, additional campus collections, archives and library staff will be invited to attend the workshop. This project will accommodate all interested students working with committed faculty and staff.

The potential for continuing the project after the planning period will become credible during the consultation appointments to occur during the 5-day workshop. The consulting conservator will organize and implement a basic outline and agenda for future planning meetings when convening with individual departments. The new emergency plan web site will be launched the same week of the campus workshop and aid in the design of future department emergency plans. Future grant opportunities will be posted at the site. ASUAM museum study interns will update and maintain the website.

### **3. How does the project budget support the education component goals and objectives?**

The initial conservation project budget serves as the foundation for the education component goals and objectives. The ASU AM emergency plan when finished will be a pilot program and model for a university department emergency response plan concerned with cultural property protection. A major portion of the plan will provide a template for ASU policy and procedure and State of Arizona agency policy and procedure. Which departments can efficiently duplicate so as to allow more time for developing collaborations and specific collections mitigation plans.

Cost factors are reasonable and appropriate and at bare minimum. The university infrastructure supports much of the student, staff and emergency responder contributions needed to present this program. Both Project Grant and Education Component presenters involve the same personnel so duplicate time for training and expense have been eliminated.

### **4. What are the qualification and responsibilities of the project personnel?**

Terri Schindel, Conservator, will serve as the consulting conservator for the education component of the project. Terri has 18 years of experience and serves as regional advocate for the conservation needs of institutions operating with no or little availability to staff or local (AIC) conservators. See Appendix; Resumes.

Anne Sullivan, ASUAM Registrar, has 15 years experience as a Museum Registrar working on university campuses and is well qualified to teach the intricacies of intra-departmental project planning. She has served as an MAP II consultant and grant reviewer for IMLS applications. See Appendix; Resumes.

Additional presenters and confirmed campus participants summarized in Appendix; Part II Campus Participants, Campus Maps with Participant Descriptions.

## Project Budget Form Front

## SECTION 2: DETAILED BUDGET - EDUCATION COMPONENT

Name of Applicant ASUAM Campus-Wide Emrgncy Training Wksh (If Applicable)

IMPORTANT! READ INSTRUCTIONS IN PART 4 BEFORE PROCEEDING.

## SALARIES AND WAGES (PERMANENT STAFF)

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Anne Sullivan, Rgstr	(1)	270 hrs (\$20 per hr)	5,400		\$5,400
Tiffany Fairall, Ast. Rg:	( )	50 hrs (\$13 per hr)			
	( )				
	( )		650		\$650
<b>TOTAL SALARIES AND WAGES</b>			<b>\$ 6,050</b>		<b>\$6,050</b>

## SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)

NAME/TITLE	No.	METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Student - Website	(1)	15 hrs per week for 12 weeks		1,800	\$1,800
	( )	180 hrs (\$10 per hr)			
Student - Workshop	(1)	15 hrs per week for 6 weeks	900		\$900
Coodinator	( )	90 hrs (\$10 per hr)			
<b>TOTAL SALARIES AND WAGES</b>			<b>\$ 900</b>	<b>\$1,800</b>	<b>\$2,700</b>

## FRINGE BENEFITS

RATE	SALARY BASE	IMLS	MATCH	TOTAL
Sullivan at 15	% of \$ 5,400		810	\$810
Fairall at 15	% of \$ 650		98	\$98
Students at 4	% of \$ 2,700	36	72	\$108
<b>TOTAL FRINGE BENEFITS</b>		<b>\$ 36</b>	<b>980</b>	<b>\$1016</b>

## CONSULTANT FEES

NAME/TYPE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR HRS) ON PROJECT	IMLS	MATCH	TOTAL
Schindel, Conservator	650 per day	5 days	3,250		\$3,250
<b>TOTAL CONSULTATION FEES</b>			<b>\$ 3,250</b>		<b>\$3,250</b>

## TRAVEL

FROM/TO	NUMBER OF: PERSONS DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	MATCH	TOTAL
Boulder, CO/Tempe	(1) ( )		425	425		\$425
Hotel (6 nights)	(1) (6)	600(100/dy)		600		\$600
7 days per diem	(1) ( )	350(50/dy)		350		\$350
2 travel days	(1) ( )	650 per dy		1300		\$1,300
<b>TOTAL TRAVEL COSTS</b>				<b>\$ 2675</b>		<b>\$2,675</b>

## Project Budget Form Back

### SECTION 2 - EDUCATION COMPONENT-CONTINUED

**MATERIALS, SUPPLIES, AND EQUIPMENT**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
Workshop - Disaster	Emergency response kit (1000)	1,375		\$1,375
Prep supplies	75 brochures (375)			
For 30 participants	75 questionnaires			
	Agenda, referral sheets			
<b>TOTAL COST OF MATERIAL, SUPPLIES, &amp; EQUIPMENTS</b>		1,375		\$1,375

**SERVICES**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<b>TOTAL SERVICES</b>		\$		

**OTHER**

ITEM	BASIS/METHOD OF COST COMPUTATION	IMLS	MATCH	TOTAL
<b>TOTAL COST OF OTHER</b>		\$		

<b>TOTAL DIRECT PROJECT COSTS</b>	<b>\$</b>	8,236	\$8,830	\$17,066
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